Trends in Healthcare Expenditures among Individuals with Arthritis in the United States from 2008 to 2014

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ABSTRACT. ***Objective.*** With the expected rise in the arthritis population, information is required regarding trends of healthcare expenditures among individuals with arthritis in the United States. We examined temporal trends in direct and out-of-pocket (OOP) healthcare expenditures among individuals with arthritis using a nationally representative database, the Medical Expenditures Panel Survey.

Methods. The study population was composed of cross-sectional cohorts of individuals aged ≥ 18 years from 2008 to 2014. Two-part models were used to estimate the incremental total and types of annual direct and OOP healthcare expenditures (adjusted to 2014 US dollars) for arthritis, after controlling for predisposing, enabling, need, personal health practice, and external environmental factors, as per the Anderson Healthcare Behavioral Model.

Results. An annual weighted arthritis population rose from 56.1 million in 2008 to 65.1 million in 2014. Among individuals with arthritis, the annual average direct and OOP expenditure was $10,424 [standard error (SE) = $345, aggregate = $584.8 billion] and $1493 (SE = $50, aggregate = $83.8 billion) in 2008, respectively, and $910 (SE = $279, total = $645.1 billion) and $1099 (SE = $36, aggregate = $71.5 billion) in 2014, respectively. In the fully adjusted model, individuals with arthritis had significantly greater total and OOP expenditures from 2008 to 2014; however, the magnitude of incremental OOP expenditure declined from 2008 to 2014.

Conclusion. Although the annual direct healthcare expenditures per person remained stable over the years, the rise in proportion of the arthritis population led to a huge increase in aggregate economic burden to the US healthcare system. (J Rheumatol First Release January 15 2018; doi:10.3899/jrheum.170368)

Key Indexing Terms:
ARTHRITIS
DIRECT HEALTHCARE EXPENDITURES
OUT-OF-POCKET EXPENDITURES
MEDICAL EXPENDITURE PANEL SURVEY

Arthritis, the leading cause of disability among adults in the United States[1], affects about 52.5 million US individuals[2,3]. The significant disease burden of arthritis could translate into a huge economic burden[4,5]. Although previous studies have determined healthcare expenditures among individuals with arthritis in the United States[3–11], estimates of healthcare expenditures from these studies were obsolete[3–11], limited to a particular type of arthritis[6,7,8], restricted to direct with limited information on out-of-pocket (OOP) expenditures[7,8], or included people having arthritis combined with joint pain or other rheumatic conditions[10,11]. Except for a study by Cisternas, *et al*[4], none of the studies provided information on changes in total expenditure and types of healthcare expenditures across years among individuals with arthritis. Cisternas, *et al* estimated direct healthcare expenditures of $252 billion (2005 US$) in 1997 among individuals with arthritis, and the figure rose to $353 billion in 2005[4]. Hootman, *et al* projected an increase in the number of individuals with arthritis to 78 million by 2040 in the United States[3]; therefore, it is important to determine trends in healthcare expenditures among these individuals to guide health policy makers in allocating budgets and designing interventions to efficiently manage a highly prevalent and priority health condition.

To our knowledge, there has been no updated information in the last 10 years about current trends in healthcare expenditures among individuals with arthritis from a nationally representative database. Understanding trends in healthcare expenditures among these individuals will assist in developing strategies to curb excessive healthcare expenditures. Therefore, the primary objective of our study was to assess trends in direct and OOP annual healthcare expenditures among individuals with and without arthritis using nationally representative data of the US population from 2008 to 2014.

MATERIALS AND METHODS

Study design and data source. We used a retrospective cross-sectional trend design to estimate healthcare expenditures among individuals with and

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without arthritis using the Medical Expenditure Panel Survey (MEPS) data. MEPS provides nationally representative estimates of healthcare use, expenditures, prescription medications, source of payment, health status, and health insurance coverage from the US noninstitutionalized civilian population[12] (Supplementary Data 1, available with the online version of this article). We used 2 data files: a full-year household consolidated (HC) data file, and a medical condition data file for each year from 2008 to 2014. The HC data file has information on healthcare expenditures, diagnoses of priority conditions, and demographic, socioeconomic, health, and personal healthcare practice. The medical condition data file contains information on 3-digit codes from the International Classification of Diseases-9-Clinical Modification (ICD-9-CM), as well as clinical classification codes. Survey respondents reported the presence of conditions. Once clinical conditions were reported in exactly the same words as were used originally, professional coders transferred the responses to 5-digit ICD-9 codes, but released only 3-digit ICD-9 codes, to preserve participant confidentiality[12,13,14]. Survey response for annual files ranged from 60% in 2008 to 50% in 2014[13]. Because our study was conducted using a publicly available unrestricted and deidentified survey database, it was considered exempt by the University of Rhode Island Institutional Review Board.

Study cohort. The study cohort was composed of noninstitutionalized US individuals age ≥ 18 years with and without arthritis alive during each calendar year from 2008 to 2014.

Dependent variables. Total direct healthcare expenditures per person per year was the dependent variable of interest. These expenditures referred to payments for medical events, including inpatient visits, emergency room (ER) visits, outpatient services including office-based physician visits, home healthcare visits, prescription drugs, and other associated costs. Payment referred to direct payment from individuals (OOP), private insurance, Medicaid, Medicare, and other sources for each calendar year. In addition, expenditures were also classified according to cost types, such as inpatient, outpatient, prescription, ER, and "other" categories. "Other" expenditures included home health, vision, durable medical equipment, ambulance services, orthopedic items, hearing devices, prosthesis, bathroom aids, medical equipment, disposable supplies, and other miscellaneous items or services rented or purchased during the calendar year. Total OOP expenditures comprised self-reported payments for coinsurance, deductibles, cash outlays for services, supplies, and other items not covered by health insurance. All direct and OOP expenditures were inflated to 2014 constant dollars using the annual consumer price index for medical care obtained from the Bureau of Labor Statistics[15]. Additionally, based on research on inflation indices by Dunn, *et al*[16], we presented aggregate total direct and OOP expenditures using Personal Care Expenditure-Health (PCEH) index with a sensitivity analysis.

Arthritis as key independent variable. Self-reported arthritis was the key independent variable. The Agency for Healthcare Research and Quality has specified a group of medical conditions, including arthritis, as priority conditions. Therefore, MEPS collects detailed information on the list of priority conditions[14]. We defined presence of arthritis if a survey participant responded with "Yes" to the following survey question: "(Have/Has) (person) ever been told by a doctor or other health professional that (person) had arthritis?" The self-reported measure of arthritis from the MEPS survey data is a commonly used measure of treated prevalence of the condition[17]. Based on this definition, an annually weighted population of 56.1 million (weighted % = 24.8%, unweighted N = 4967) reported presence of arthritis in 2008, which rose to 65.1 million (weighted % = 27.0%, unweighted N = 5779) in 2014 (Table 1A).

Other independent variables. The Anderson Behavioral Model of Health Services Utilization was used to identify the predictors of direct healthcare expenditures among individuals with and without arthritis. According to this model, predisposing, enabling, need-related, personal health practice, and external environmental healthcare factors influence health services use[18] (Supplementary Data 2, available with the online version of this article). Predisposing factors consisted of age, sex, and race/ethnicity. Enabling resources were marital status, income, health insurance, and employment status. Need-related factors consisted of perceived physical and mental health status, and co-occurring chronic conditions categorized into total number of physical and mental health conditions. Self-reported perceived mental and physical health status were identified during multiple rounds in a given calendar year. In that case, we did a hierarchical approach by identifying values of responses in the last round during a particular year, followed by responses for the previous rounds in cases of missing values in the last rounds. We determined the list of conditions based on the guidance document from the Office of the Assistant Secretary of Health[19], as well as common chronic conditions identified among individuals with arthritis using all clinical classification codes. Applying these criteria, we included all MEPS priority conditions (high blood pressure, heart disease, stroke, emphysema or chronic bronchitis, high cholesterol, cancer, diabetes, and asthma), gastrointestinal disorders, endocrinology or metabolic disorders, kidney diseases, and eye disorders. In addition, we defined the number of mental health conditions by summing up the presence of any of anxiety, depression, schizophrenia, substance abuse, or dementia. We also identified the functional limitations if an individual had restricted ability to work because of experienced pain or a disability, or had self-reported joint pain[20]. In addition, we identified common acute conditions, such as infections or acute injury. Personal health practice–related factors consisted of body mass index, current smoking status, and exercise. External environmental factors consisted of census-defined regions (Supplementary Table 1, available with the online version of this article).

Statistical analysis. Separate chi-square statistics were used to examine differences in all the independent characteristics according to the presence of arthritis for each year. We also reported difference in prevalence of all independent characteristics from 2008 to 2014, along with the respective 95% CI and p values to reflect the changes in the composition of individuals with and without arthritis from 2008 to 2014. To account for individuals with zero expenditures, a 2-part model known as mixed discrete-continuous variable regression was used to estimate incremental healthcare expenditures among individuals with arthritis compared to those without[21]. In the first part, a probit model was used to determine the probability of zero expenditure versus positive healthcare expenditures. In the second part, a generalized linear model with log link and gamma distribution was used to determine conditional expenditures for those with positive healthcare expenditures[22]. Postregression predicted estimates (i.e., margins), and provided unadjusted and adjusted incremental healthcare expenditures among individuals with arthritis compared to those without arthritis from 2008 to 2014. We reported estimates for 4 adjusted models with the following covariates: (1) unadjusted as no covariate except presence of arthritis; (2) Model 1 plus predisposing factors; (3) Model 2 plus enabling factors; and (4) Model 3 plus need-related, personal healthcare practice, and external environmental factors. Delta method was used to estimate 95% CI. We confirmed absence of multicollinearity among covariates using variance inflation factor, tolerance, and eigenvalues. We considered presence of significant collinearity with variance inflation factor ≥ 5, tolerance < 0.20, or relatively high eigenvalues with condition index > 30. All the analyses were performed using SAS 9.4 and Stata 14, and accounted for complex survey design.

RESULTS

Description of study cohort. Table 1B describes distributions of predisposing, enabling, need, lifestyle, and external environmental factors according to the presence of arthritis. There were significant differences in all characteristics between individuals with and without arthritis across all years, expressed in range. Across 2008 to 2014, individuals with arthritis were mostly middle aged (45.0%–46.1%) or elderly (39.3%–42.5%), female (59.5%–61.8%), white (74.4%–78.1%), married (54.5%–57.3%), with high income

Table 1A. Individuals with and without arthritis using the Medical Expenditure Panel Survey from 2008 to 2014.

No. Individuals	2008	2009	2010	2011	2012	2013	2014	2014 vs 2008, % (95% CI)	p
Arthritis									
Unweighted N	4967	5784	5355	5470	5925	5794	5779	2.2 (0.9–3.5)	
Weighted N, million	56.1	57.7	58.7	57.6	60.4	62.1	65.1		
Weighted %	24.8	25.3	25.4	24.6	25.6	26.0	27.0		**
Non-arthritis									
Unweighted N	16,877	18,774	16,866	18,461	20,511	19,118	17,823	–2.2 (–3.5 to –0.9)	
Weighted N, million	170	171	172	176	176	176	176		
Weighted %	75.2	74.7	74.6	75.4	74.4	74.0	73.0		**

(36.1%–40.6%), and with excellent or very good perceived physical health status (37.7%–39.7%) and mental health status (52.9%–54.7%), with limitation in doing routine physical activity (29.1%–34.1%) and pain limiting ability to work (41.5%–45.3%). They were also past smokers/nonsmokers (79.8–83.2%), with limited physical activity (50.3%–59.9%), obese (38.0%–41.4%), and they resided in the South (37.0%–38.7%). The proportion of individuals with ≥ 2 physical chronic conditions ranged from 42.6% to 44.7%, and those with ≥ 1 mental health condition ranged from 26.5% to 32.4%. Further, the most common chronic physical health conditions were hypertension (58.0%–60.6), hyperlipidemia (53.1%–55.6%), heart disease (28.4%–31.0%), cancer (20.0%–21.8%), and diabetes (17.2–20.2%), while depression (16.8%–20.5%) and anxiety (12.7%–18.3%) were the most common mental health conditions among individuals with arthritis (Supplementary Table 2, available with the online version of this article).

Regarding changes between 2008 and 2014 in the composition of characteristics among individuals with arthritis, we observed an increase in proportion of individuals who were Hispanic (6.9% vs 9.0%, $p < 0.001$), were poor (11.7% vs 13.7%, $p < 0.05$), had activity limitations (29.1% vs 32.3%, $p < 0.01$), and were nonsmokers or past smokers (79.8% vs 83.2%, $p < 0.001$). On the other hand, there was a decline in proportion of individuals with arthritis who were white (78.0% vs 74.4%, $p < 0.001$), widowed (15.7% vs 13.4%, $p < 0.01$), had middle income (28.4% vs 25.9%, $p < 0.05$), and had pain limiting ability to work (44.1% vs 41.5%, $p < 0.01$). Similar trends were observed for individuals without arthritis. Further, from 2008 to 2014, we noted an increase of 6 percentage points in the proportion with ≥ 1 mental health condition among those with arthritis (26.5% vs 33.0%, $p < 0.01$), and an increase of 2 percentage points among those without arthritis (13.3% vs 15.8%, $p < 0.01$).

Average annual healthcare expenditures for arthritis versus non-arthritis. Among individuals with arthritis, average annual total healthcare expenditures declined from $10,424 in 2008 to $9910 in 2014 (Table 2). The top 3 ranked expenditure categories were outpatient (32.6%), inpatient (29.0%), and prescription drug costs (24.7%) in 2008, and changed to outpatient (33.8%), prescription drug (26.8%), and inpatient costs (26.4%) in 2014 (Figure 1). Average annual total OOP was $1493, representing 14% of total healthcare expenditures in 2008, which declined to $1099 in 2014 (Table 2 and Supplementary Table 3, available with the online version of this article). Similar trends were observed among individuals without arthritis.

To provide insight through 3 key predisposing factors, we estimated total direct and OOP healthcare expenditures by age, sex, and race/ethnicity among individuals with arthritis (Figure 2). There was a slight decline in total direct healthcare expenditures among elderly individuals (≥ 65 yrs) with arthritis from $11,200 in 2008 to $10,483 in 2014, while the expenditures among non-elderly (18-64 yrs) individuals with arthritis remained stable. Men and women had relatively similar total direct and OOP expenditures. Whites had consistently higher total direct and OOP healthcare expenditures compared to African Americans or other races.

Average incremental healthcare expenditures: arthritis versus non-arthritis. Without adjustment of covariates, individuals with arthritis had $6974 and $6318 higher healthcare expenditures compared to those without arthritis in 2008 and 2014 respectively (Table 3). Magnitude of incremental total healthcare expenditures among individuals with arthritis declined to $4116 (about 59% of incremental expenditures from model 1) after adjusting for predisposing factors in model 2, $4123 (59% of incremental expenditures from model 1) after adjusting for predisposing and enabling factors in model 3, and $2000 (29% of incremental expenditures from model 1) after adjusting predisposing, enabling, need, lifestyles, and external environment in model 4 for the year 2008. Almost 71% of the difference in total healthcare expenditures between individuals with and without arthritis was explained by the differences (expressed as %) in predisposing factors (41%), enabling factors (about 0%), need, lifestyle, and external environmental factors (30%). Those factors again explained 72%, 77%, 70%, 62%, 67%, and 74%, respectively for each year from 2009 to 2014, in incremental difference in healthcare expenditures between individuals with and without arthritis. With respect to individual covariates, differences in age, perceived health status, and number of physical and mental health conditions explained a majority of incremental total healthcare expenditures

Table 1B. Characteristics of individuals with and without arthritis using MEPS data from 2008 to 2014. Values are % unless otherwise specified.

Characteristics	Arthritis, Weighted									Non-arthritis, Weighted								
	2008	2009	2010	2011	2012	2013	2014	2014 vs 2008, % Change (95% CI)	p	2008	2009	2010	2011	2012	2013	2014	2014 vs 2008, % Change (95% CI)	p
Predisposing characteristics																		
Age groups***																		
18–44	14.8	15.0	14.0	13.8	14.2	12.7	13.2	–1.6 (–3.5 to 0.3)		59.9	59.7	59.5	58.3	58.4	58.8	58.9	–1.0 (–2.6 to 0.6)	
45–64	45.1	45.6	46.1	45.0	44.2	44.7	44.7	–0.4 (–3.0 to 2.2)		31.2	31.2	31.3	31.8	31.3	30.9	30.6	–0.7 (–2.1 to 0.8)	
≥ 65	40.1	39.3	40.0	41.3	41.6	42.5	42.1	2.0 (–0.8 to 4.8)		8.9	9.1	9.3	10.0	10.3	10.3	10.6	1.7 (0.6–2.7)	**
Sex***																		
Female	60.7	60.5	61.1	61.8	60.0	59.5	60.9	0.2 (–1.9 to 2.1)		48.6	48.7	48.4	48.6	49.1	49.0	48.4	–0.2 (–1.1 to 0.8)	
Male	39.3	39.5	38.9	38.2	40.0	40.5	39.1	–0.2 (–2.1 to 1.7)		51.4	51.3	51.6	51.4	50.9	51.0	51.6	0.2 (–0.8 to 1.1)	
Race***																		
White	78.1	77.5	76.5	75.4	75.8	75.2	74.4	–3.7 (–5.5 to –1.9)	***	65.0	64.9	64.6	63.7	62.7	61.7	60.6	–4.4 (–6.3 to –2.5)	***
AA	10.5	10.8	11.2	11.3	11.3	11.4	11.2	0.7 (–0.7 to 2.1)		11.8	11.6	11.7	11.5	11.6	11.6	12.0	0.2 (–0.8 to 1.1)	
Hispanic	6.9	7.4	8.1	8.7	8.2	8.2	9.0	2.1 (1.1–3.0)	***	16.0	16.0	16.2	16.9	17.3	17.7	17.9	1.9 (0.5–3.3)	**
Other/missing	4.5	4.2	4.3	4.6	4.7	5.2	5.5	0.9 (0.0–1.9)	*	7.2	7.4	7.6	7.9	8.4	8.9	9.6	2.3 (1.3–3.4)	***
Enabling characteristics																		
Marital status***																		
Married	56.2	57.3	56.4	54.7	54.5	54.8	57.0	0.8 (–1.9 to 3.4)		53.4	52.3	52.1	51.9	51.8	51.6	50.7	–2.8 (–4.4 to –1.1)	***
Widow	15.7	15.2	14.8	15.0	14.3	14.4	13.4	–2.3 (–4.0 to –0.6)	**	3.4	3.5	3.1	3.1	3.3	3.3	3.3	–0.1 (–0.6 to 0.4)	
Separate/ divorced	18.7	17.9	18.8	19.8	19.9	19.9	18.9	0.2 (–1.9 to 2.3)		12.0	12.1	11.6	11.8	12.0	11.8	11.3	–0.7 (–1.7 to 0.2)	
Never married	9.4	9.7	10.0	10.5	11.2	10.9	10.7	1.3 (–0.1 to 2.8)		31.2	32.1	33.2	33.1	33.0	33.3	34.8	3.6 (2.1–5.0)	***
Income status***																		
Poor	11.7	12.1	14.1	13.5	12.7	14.2	13.7	2.0 (0.5–3.6)	*	11.1	12.1	12.2	12.4	12.5	12.1	12.1	1.0 (–0.0 to 2.1)	
Near poor	21.6	20.6	20.6	20.6	21.4	19.8	19.8	–1.8 (–3.9 to 0.2)		16.2	16.7	16.6	17.4	17.4	17.8	16.9	0.7 (–0.5 to 1.8)	
Middle income	28.4	30.1	29.2	28.9	29.2	28.5	25.9	–2.6 (–5.0 to –0.1)	*	30.9	30.7	30.8	30.7	30.6	30.2	29.7	–1.2 (–2.7 to 0.4)	
High income	38.3	37.2	36.1	36.9	36.7	37.6	40.6	2.4 (–0.2 to 4.9)		41.8	40.5	40.4	39.5	39.5	39.9	41.3	–0.5 (–2.4 to 1.4)	
Need factors																		
Perceived physical health status***																		
Excellent/very good	38.7	37.8	37.7	38.9	38.7	39.4	39.7	0.1 (–1.4 to 3.3)		65.7	65.8	66.6	66.1	65.6	66.8	67.0	1.3 (–0.4 to 3.0)	
Good	33.2	34.3	35.0	33.9	34.2	33.6	34.0	0.79 (–1.6 to 3.2)		25.8	26.2	25.4	26.1	26.0	25.4	25.0	–0.8 (–2.4 to 0.7)	
Fair/poor	28.1	27.9	27.4	27.3	27.2	27.1	26.3	–1.8 (–3.8 to 0.3)		8.6	8.1	8.0	7.8	8.4	7.9	8.1	–0.5 (–1.3 to 0.3)	
Perceived mental health status***																		
Excellent/very good	54.7	54.5	53.6	52.9	53.4	53.0	54.0	–0.8 (–3.2 to 1.7)		72.5	72.3	73.3	72.0	71.5	72.0	72.0	–0.6 (–2.1 to 1.0)	
Good	31.1	31.5	32.0	33.2	31.7	32.8	31.6	0.6 (–1.9 to 3.0)		22.6	22.8	21.6	22.6	22.7	22.7	22.5	–0.0 (–1.4 to 1.3)	
Fair/poor	14.2	14.0	14.3	13.8	14.9	14.2	14.4	0.2 (–1.5 to 1.8)		4.9	4.9	5.1	5.4	5.8	5.3	5.5	0.6 (–0.0 to 1.3)	
No. mental health conditions***																		
0	73.5	72.8	71.4	70.0	69.1	67.6	67.6	–5.9 (–8.1 to –3.7)	***	86.7	86.2	86.4	86.1	85.4	84.9	84.2	–2.0 (–4.0 to –1.0)	***
≥ 1	26.5	27.2	28.6	30.0	30.9	32.4	32.4	5.9 (3.7–8.1)	***	13.3	13.8	13.6	13.9	14.6	15.1	15.8	2.0 (1.0–4.0)	***
No. physical health conditions***																		
0	13.6	14	13.4	13.7	14.3	13.7	14	0.4 (–1.3 to 2.2)		52.7	52.5	52.5	53	52.3	52	52.6	0.1 (–1.7 to 1.4)	
1	43.8	44.1	44.1	43.9	44.1	41.7	41.8	–2.0 (–4.1 to 0.2)		37.6	37.8	37.8	36.8	37.5	37.7	37.1	0.5 (–1.8 to 0.8)	
≥ 2	42.6	42	42.5	42.5	41.6	44.7	44.2	1.5 (–0.6 to 0.8)		9.7	9.7	9.6	10.2	10.2	10.3	10.4	0.6 (–0.2 to 1.5)	

Table 1B. Continued.

Characteristics	Arthritis, Weighted 2008	2009	2010	2011	2012	2013	2014	2014 vs 2008, % Change (95% CI)	p	Non-arthritis, Weighted 2008	2009	2010	2011	2012	2013	2014	2014 vs 2008, % Change (95% CI)	p
Activity limitation***	29.1	29.8	29.7	30.6	31.8	34.1	32.3	3.1 (0.8–5.4)	**	5.8	5.5	5.4	5.7	6.3	6.3	6.8	0.9 (0.2–1.6)	*
Pain at work***	44.1	43.2	43.7	44.2	45.3	42.7	41.5	–2.6 (–5.0 to –0.3)	*	11.4	11.9	11.3	12.2	12.9	10.6	9.4	–2.0 (–2.9 to –1.1)	***
Joint pain***	86.5	86.0	85.7	86.7	85.7	87.6	88.0	1.4 (–0.3 to 3.1)		31.6	30.5	30.0	30.3	29.8	32.3	33.1	1.6 (–0.0 to 3.2)	
Personal healthcare practice																		
Smoking status***																		
Current smoker	20.2	18.5	19.6	19.1	18.9	18.7	16.8	–3.8 (–5.6 to –2.0)	***	20.0	18.9	17.4	17.5	17.7	16.1	14.4	–5.7 (–6.7 to –4.8)	***
Past/nonsmoker	79.8	81.5	80.4	80.9	81.1	81.3	83.2	3.8 (2.0–5.6)	***	80.0	81.1	82.6	82.5	82.3	83.9	85.6	5.7 (4.8–6.7)	***
Physical activity***																		
> 3 ×/wk	46.5	48.2	49.7	40.1	40.2	41.9	43.9	–2.8 (–5.4 to –0.2)	*	60.6	63.2	63.9	53.0	52.7	52.3	53.7	–7.0 (–8.8 to–5.3)	***
No exercise	53.5	51.8	50.3	59.9	59.8	58.1	56.1	2.8 (0.2–5.4)	*	39.4	36.8	36.1	47.0	47.3	47.7	46.3	7.0 (5.3–8.8)	***
BMI categories																		
Underweight/ normal	26.5	25.5	26.1	27.1	26.7	25.6	25.0	–1.4 (–3.3 to 0.6)		39.4	39.0	39.0	39.8	39.9	39.3	38.7	–0.8 (–2.2 to 0.6)	
Overweight	35.5	35.1	34.1	33.4	33.0	33.0	34.3	–1.1 (–3.4 to 1.2)		35.1	35.4	35.0	34.1	33.9	33.9	34.8	–0.3 (–1.6 to 1.0)	
Obese	38.0	39.4	39.8	39.5	40.3	41.4	40.6	2.6 (0.4–4.8)	*	25.4	25.5	26.0	26.1	26.2	26.8	26.5	1.0 (–0.3 to 2.3)	
External environmental factors																		
Region																		
Northeast	18.8	19.3	19.2	18.3	18.1	18.4	18.1	–0.7 (–2.8 to 1.5)		18.3	18.2	18.2	18.3	18.2	18.2	18.0	–0.3 (–2.3 to 1.7)	
Midwest	24.1	24.2	24.3	23.2	23.6	24.4	24.3	0.3 (–2.7 to 2.8)		21.2	21.0	20.8	20.9	20.6	20.2	20.3	–0.9 (–2.9 to 1.1)	
South	37.8	37.6	37.0	39.1	38.7	38.0	38.4	0.5 (–2.4 to 3.5)		36.1	36.3	36.6	36.3	36.7	36.7	36.8	0.7 (–1.5 to 3.0)	
West	19.3	18.9	19.5	19.5	19.6	19.2	19.2	–0.2 (–2.1 to 1.8)		24.4	24.5	24.4	24.5	24.6	24.9	24.9	0.5 (–1.4 to 2.4)	

* $0.01 \le p < 0.05$. ** $0.001 \le p < 0.01$. *** $p < 0.001$. Estimates were based on individuals aged ≥ 18 years, and alive during each calendar year, using MEPS from 2008 to 2014. Survey-weighted logistic regression was used to derive changes in proportion of individuals with different characteristics among both arthritis and non-arthritis populations. There were significant differences between individuals with and without arthritis for all characteristics using chi-square test. AA: African American; BMI: body mass index; MEPS: Medical Expenditure Panel Survey.

Table 2. Average total and types of healthcare expenditures among individuals with and without arthritis, using MEPS data from 2008 to 2014. Values are adjusted 2014 US dollars.

Year	Arthritis		Non-arthritis		p [†]
	Mean	95% CI	Mean	95% CI	
Total direct healthcare expenditures					
2008	10,424	9744–11,103	3450	3274–3627	***
2009	10,568	9959–11,177	3645	3485–3804	***
2010	10,141	9547–10,734	3695	3482–3908	***
2011	10,635	9780–11,490	3759	3512–4007	***
2012	10,450	9616–11,283	3386	3178–3595	***
2013	10,169	9559–10,779	3321	3126–3516	***
2014	9910	9359–10,460	3592	3331–3854	***
Inpatient					
2008	3021	2573–3468	850	739–961	***
2009	2941	2526–3357	930	821–1039	***
2010	3166	2736–3596	1017	880–1154	***
2011	3317	2591–4043	978	857–1099	***
2012	3274	2725–3823	941	804–1077	***
2013	2743	2373–3113	866	739–994	***
2014	2601	2240–2961	792	662–923	***
Emergency room					
2008	280	235–326	167	144–190	***
2009	310	268–352	186	165–207	***
2010	300	260–339	169	147–191	***
2011	286	247–324	180	159–200	***
2012	293	262–323	185	166–204	***
2013	349	305–392	172	155–189	***
2014	380	308–452	178	157–199	***
Outpatient					
2008	3399	3061–3737	1200	1129–1271	***
2009	3658	3339–3976	1311	1237–1386	***
2010	3088	2873–3303	1330	1213–1447	***
2011	3219	3022–3416	1346	1261–1430	***
2012	3321	3003–3638	1126	1055–1197	***
2013	3414	3113–3715	1133	1069–1198	***
2014	3348	3065–3631	1320	1216–1424	***
Prescription drugs					
2008	2577	2430–2724	763	721–804	***
2009	2569	2406–2731	749	705–793	***
2010	2542	2396–2688	774	714–834	***
2011	2715	2523–2907	823	651–996	***
2012	2491	2323–2660	731	654–807	***
2013	2699	2481–2916	690	619–760	***
2014	2651	2450–2851	794	676–912	***
Other [a]					
2008	1147	995–1299	471	430–512	***
2009	1091	927–1254	469	425–512	***
2010	1045	913–1177	405	368–442	***
2011	1097	949–1246	433	399–466	***
2012	1071	911–1231	405	356–453	***
2013	965	875–1055	460	418–501	***
2014	931	832–1029	508	424–593	***
Total OOP					
2008	1493	1395–1591	704	666–743	***
2009	1387	1286–1487	634	604–663	***
2010	1268	1201–1335	608	576–641	***
2011	1296	1213–1380	599	570–628	***
2012	1280	1162–1399	568	530–606	***
2013	1260	1151–1368	554	520–588	***
2014	1099	1029–1169	531	500–562	***

[†]p: significant group differences in healthcare expenditures between those with arthritis and those without arthritis based on 2-part regression models. *** $p < 0.001$. [a] Includes home health, vision, dental, and miscellaneous expenditures. Based on data of individuals aged ≥ 18 years, and alive during each calendar year in MEPS from 2008 to 2014. MEPS: Medical Expenditure Panel Survey; OOP: out-of-pocket expenditures.

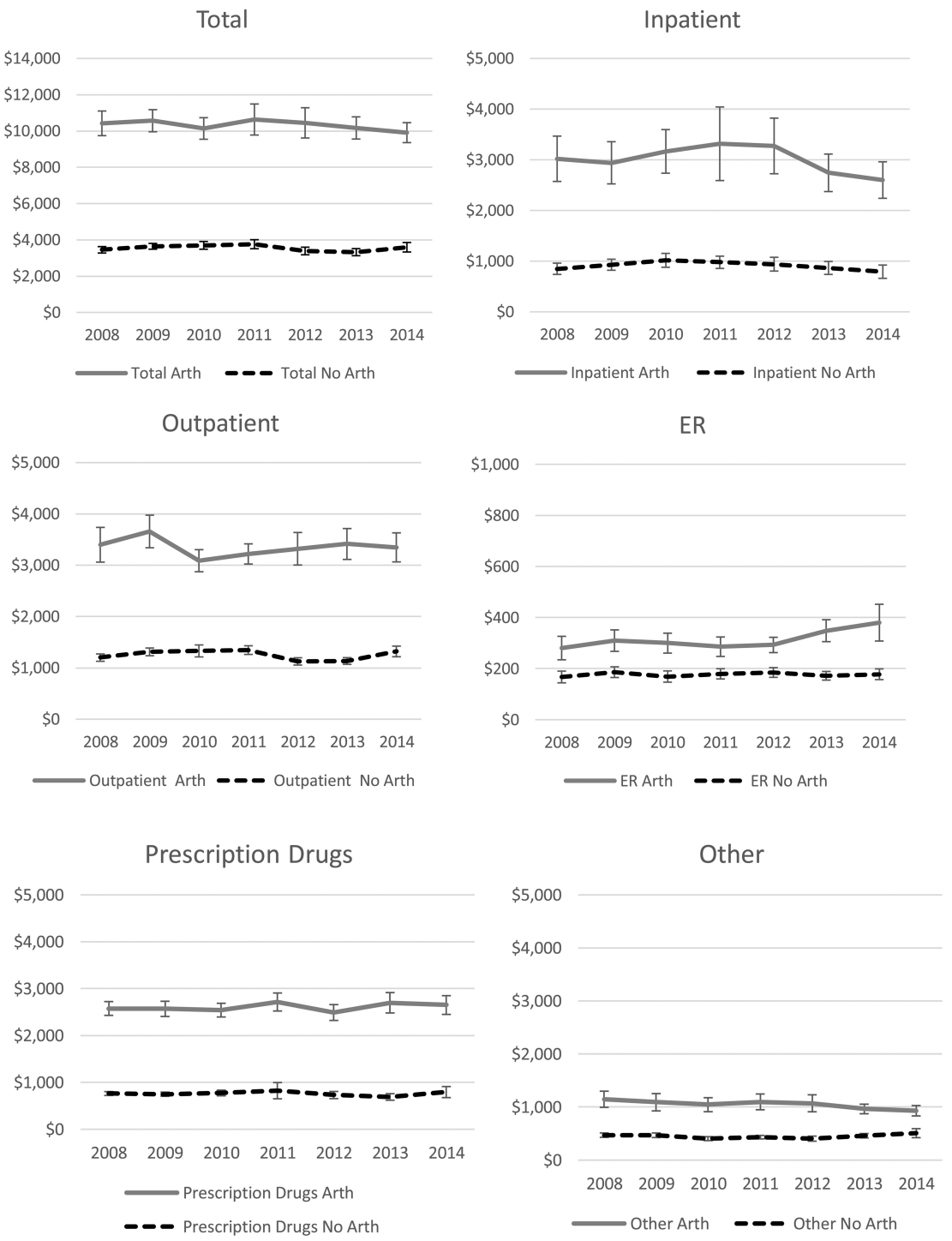

Figure 1. Trends in average annual healthcare expenditures among individuals with and without arthritis, 2008 to 2014. Arth: arthritis; ER: emergency room.

between individuals with and without arthritis (data not shown).

Regarding expenditures by types of specific services, individuals with arthritis had significantly higher inpatient, outpatient, emergency, prescription drug, and OOP expenditures compared to those without arthritis across years in adjusted analyses. After adjusting for need-related and personal health practice factors in model 4, incremental expenditures

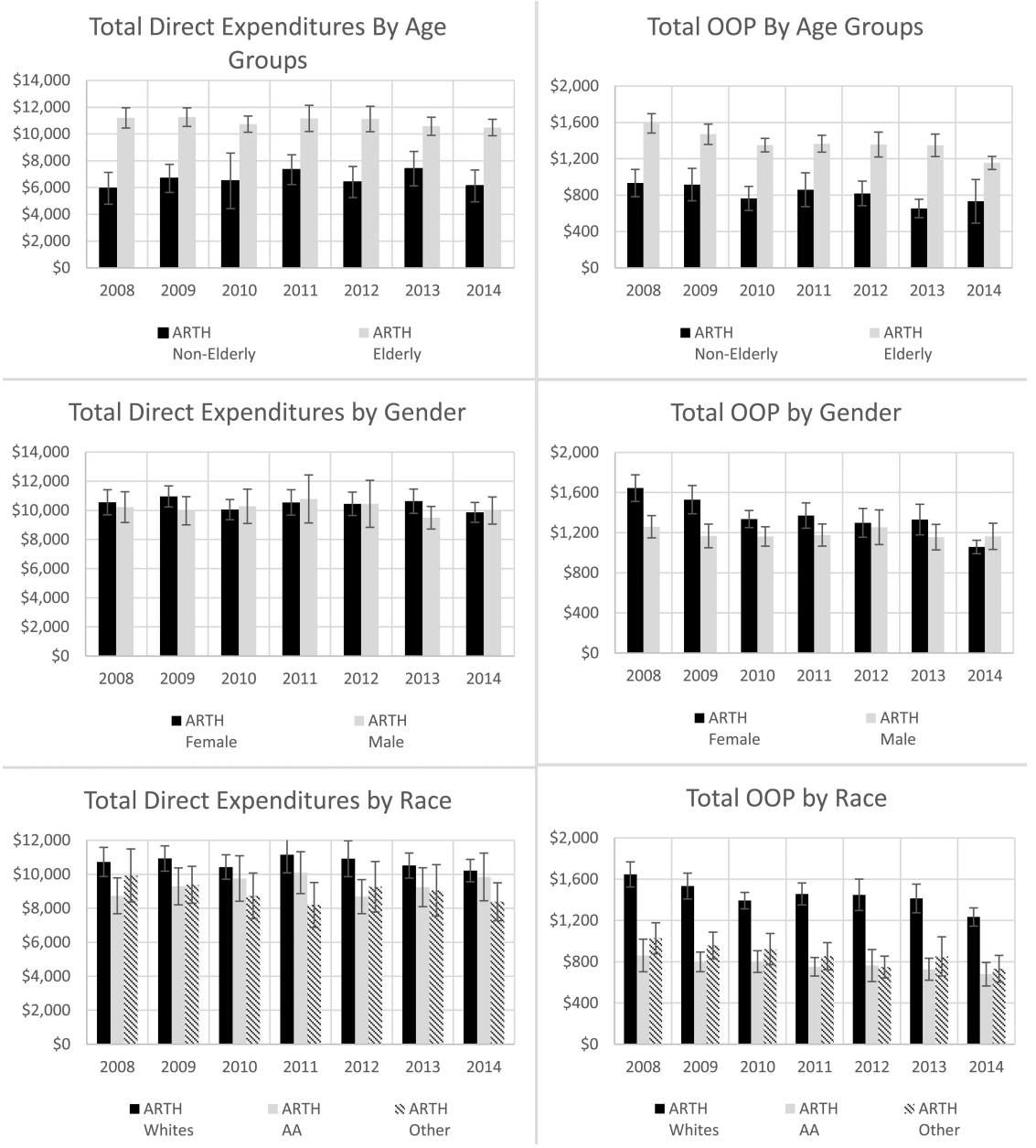

Figure 2. Trends in total direct healthcare and OOP expenditures by predisposing characteristics among individuals with arthritis, 2008 to 2014. Arth: arthritis; AA: African American; OOP: out-of-pocket.

because of inpatient services were significantly greater for 2008 and 2012, and were greater for outpatient services and prescription drugs for all the years among individuals with arthritis compared to those without. With respect to magnitude of incremental expenditures over the years, individuals with arthritis had greater total incremental expenditures for 2012 and 2013 ($2654 and $2284), which corresponded to greater outpatient expenditures for those years ($935 and $980, respectively) in fully adjusted model 4.

Estimated direct aggregate expenditures for individuals with arthritis. Aggregate burden estimates were calculated by multiplying a weighted population of arthritis with per patient estimate of healthcare expenditures. For individuals with arthritis, aggregate (sum of) annual direct expenditures increased from $584.8 billion in 2008 to $645.1 billion in 2014, whereas OOP declined from $83.8 billion in 2008 to $71.5 billion in 2014 for individuals with arthritis (Table 4). Sensitivity analyses using PCEH-adjusted expenditures is shown in Supplementary Table 4A and 4B (available with the online version of this article). After adjustment for all independent characteristics, aggregate annual direct expenditures rose from $112.2 billion in 2008 to $160.3 billion in

Table 3. Trends in incremental direct healthcare expenditures among individuals with arthritis compared to those without arthritis from 2008 to 2014. Values are adjusted 2014 US dollars unless otherwise specified.

Year	Covariate Adjustments											
	Model 1: Unadjusted [a]			Model 2: P [b]			Model 3: P + E [c]			Model 4: P + E + N + Ex [d]		
	Estimate	95% CI	p†	Estimate	95% CI	p†	Estimate	95% CI	p†	Estimate	95% CI	p†
Total												
2008	6974	6274–7673	***	4116	3482–4751	***	4123	3480–4766	***	2000	1510–2489	***
2009	6923	6304–7542	***	4099	3572–4625	***	4000	3498–4502	***	1920	1466–2374	***
2010	6446	5798–7093	***	3549	2788–4310	***	3484	2730–4238	***	1470	777–2163	***
2011	6876	5993–7758	***	4558	3773–5343	***	4534	3757–5312	***	2062	1458–2666	***
2012	7063	6213–7913	***	4758	3954–5562	***	4681	3912–5450	***	2654	1956–3352	***
2013	6848	6206–7490	***	4531	3933–5129	***	4539	3924–5153	***	2284	1744–2824	***
2014	6318	5681–6954	***	3594	2941–4246	***	3513	2876–4150	***	1655	1061–2249	***
Inpatient												
2008	2171	1710–2631	***	1410	931–1889	***	1391	922–1860	***	768	413–1124	***
2009	2011	1587–2436	***	1163	792–1534	***	1115	761–1469	***	402	100–704	*
2010	2149	1699–2598	***	1226	728–1724	***	1141	664–1619	***	323	–55 to 702	
2011	2339	1607–3072	***	1449	892–2005	***	1460	916–2003	***	597	218–975	***
2012	2333	1762–2904	***	1677	1143–2210	***	1614	1115–2114	***	913	508–1317	***
2013	1877	1501–2253	***	1207	874–1539	***	1177	842–1512	***	504	195–814	***
2014	1808	1409–2207	***	1081	711–1451	***	1037	690–1385	***	469	182–755	***
Emergency room												
2008	113	61–165	***	94	36–151	***	93	39–147	***	12	–31 to 55	
2009	124	79–168	***	141	89–192	***	129	77–181	***	36	–9 to 82	
2010	131	83–178	***	118	57–178	***	106	45–167	***	15	–35 to 64	
2011	106	61–151	***	106	53–158	***	105	54–156	***	8	–38 to 53	
2012	108	72–144	***	105	63–148	***	101	59–144	***	15	–20 to 50	
2013	177	127–226	***	158	105–211	***	149	97–202	***	57	11–103	*
2014	202	123–281	***	176	110–243	***	184	122–245	***	70	20–119	*
Outpatient												
2008	2199	1851–2547	***	1328	1064–1592	***	1,394	1133–1655	***	763	598–927	***
2009	2346	2024–2668	***	1425	1150–1700	***	1504	1238–1770	***	771	544–998	***
2010	1758	1519–1996	***	837	607–1068	***	931	707–1155	***	440	252–629	***
2011	1874	1670–2077	***	1134	926–1343	***	1186	976–1397	***	491	311–670	***
2012	2195	1877–2514	***	1463	1192–1735	***	1504	1255–1754	***	935	704–1166	***
2013	2280	1971–2590	***	1600	1335–1864	***	1656	1386–1926	***	980	763–1196	***
2014	2028	1725–2331	***	1134	828–1440	***	1144	851–1437	***	557	282–832	***
Prescription drugs												
2008	1814	1665–1964	***	988	859–1118	***	974	846–1102	***	468	341–595	***
2009	1820	1655–1984	***	1071	915–1228	***	1043	884–1201	***	458	325–591	***
2010	1768	1614–1922	***	1020	855–1185	***	988	832–1144	***	372	211–533	***
2011	1892	1636–2148	***	1484	1080–1888	***	1369	1077–1661	***	705	442–968	***
2012	1761	1585–1936	***	1208	1012–1404	***	1162	983–1341	***	565	406–724	***
2013	2009	1779–2240	***	1356	1151–1561	***	1341	1139–1543	***	542	369–715	***
2014	1857	1628–2085	***	1137	891–1382	***	1074	856–1291	***	528	342–715	***
Other[§]												
2008	676	525–827	***	252	126–377	***	267	139,395	***	99	18–181	*
2009	622	464–780	***	250	146–354	***	224	143,304	***	76	4–148	*
2010	640	504–776	***	264	172–355	***	251	164,337	***	153	82–223	***
2011	665	524–806	***	273	184–361	***	261	171,351	***	103	30–176	*
2012	666	498–835	***	270	147–392	***	268	175,360	***	161	81–242	***
2013	505	411–599	***	176	89–262	***	182	104,261	***	67	–9 to 142	
2014	423	291–554	***	65	–79 to 209	***	91	–5,188	0.06	0	–82 to 83	
Total OOP												
2008	788	679–898	***	330	243–416	***	361	275–447	***	132	60–204	***
2009	753	649–857	***	371	285–458	***	405	318–492	***	185	110–260	***
2010	660	593–727	***	287	227–346	***	329	267–390	***	139	89–189	***
2011	697	611–784	***	358	285–431	***	384	315–453	***	166	106–226	***
2012	712	595–830	***	390	286–495	***	415	311–519	***	204	119–289	***
2013	706	596–816	***	369	282–455	***	390	301–480	***	182	112–252	***
2014	568	494–642	***	266	190–343	***	312	234–391	***	168	90–246	***

[a]Model 1: Presence of arthritis, unadjusted for other covariates. [b]Model 2: Model 1 + P. [c]Model 3: Model 2 + E. [d]Model 4: Model 3 + N + Ex. † Significant group differences in healthcare expenditures, based on 2-part regression models between those with arthritis and those without arthritis for each year. *** $p < 0.001$. ** $0.001 \le p < 0.01$. * $0.01 \le p < 0.05$. [§] Includes home health, vision, dental and miscellaneous. Based on data of individuals aged ≥ 18 years, and alive during each calendar year in the MEPS from 2008 to 2014. MEPS: Medical Expenditure Panel Survey; P: predisposing factors (age, sex, race); E: enabling factors (income, marital status); N: need factors (perceived physical health status, perceived mental health status, presence of physical chronic conditions, mental health conditions); Ex: external environment (region) + lifestyle factors (BMI categories, smoking status, physical activity status); BMI: body mass index; OOP: out-of-pocket.

Table 4. Estimated aggregate total, incremental adjusted direct, and OOP healthcare cost among individuals with arthritis. Values are in adjusted 2014 US dollars, unless otherwise specified.

Year	Total	OOP		Inpatient		Outpatient		Prescription Drugs	
		Aggregate	% of Total	Aggregated	% of Total	Aggregate	% of Total	Aggregate	% of Total
Based on raw average expenditures estimates, billion									
2008	584.8	83.8	14	169.5	29	190.7	33	144.6	25
2009	609.8	80.0	13	169.7	28	211.0	35	148.2	24
2010	595.3	74.4	13	185.8	31	181.2	30	149.2	25
2011	612.6	74.7	12	191.1	31	185.4	30	156.4	26
2012	631.2	77.3	12	197.7	31	200.6	32	150.5	24
2013	631.5	78.2	12	170.3	27	212.0	34	167.6	27
2014	645.1	71.5	11	169.3	26	217.9	34	172.6	27
Based on estimates from fully adjusted model 4, billion									
2008	112.2	7.4	7	43.1	38	42.8	38	26.3	23
2009	110.8	10.7	10	23.2	21	44.5	40	26.4	24
2010	86.3	8.2	9	19.0	22	25.8	30	21.8	25
2011	118.8	9.6	8	34.4	29	28.3	24	40.6	34
2012	160.3	12.3	8	55.1	34	56.5	35	34.1	21
2013	141.8	11.3	8	31.3	22	60.9	43	33.7	24
2014	107.7	10.9	10	30.5	28	36.3	34	34.4	32

Based on data of individuals aged ≥ 18 years, and alive during a calendar year in the Medical Expenditure Panel Survey from 2008 to 2014. OOP: out-of-pocket expenditures.

2012, then declined to $107.7 billion in 2014. However, aggregate OOP expenditures increased from $7.4 billion to $12.3 billion until 2012, then declined to $10.9 billion in 2014 (Table 4). The top 2 expenditure categories were outpatient and inpatient in 2008 and outpatient and prescription drugs in 2014.

DISCUSSION

Our study aimed to provide insights on the trends in direct and OOP healthcare expenditures among individuals with arthritis using nationally representative data for 2008 to 2014. About 1 in 5 adults had arthritis, consistent with the estimates from the US Centers for Disease Control and Prevention[2]. From 2008 to 2014, there was an increase in the proportion of Hispanics, poor, obese, and individuals with activity limitations and mental health conditions among those with arthritis as well as among those without arthritis. These findings are indicative of a change in the composition of the US population with arthritis. Further, hypertension, hyperlipidemia, and heart disease were the most common chronic conditions among individuals with arthritis and remained relatively similar across 2008 to 2014. In multivariable models, we found that incremental healthcare expenditures among individuals with arthritis were mainly driven by difference in age, health status, and chronic conditions between individuals with and without arthritis. Our findings suggest the needs of managing multiple chronic physical and mental health conditions among individuals with arthritis.

From 2008 to 2014, we noted a trend toward nonsignificant increase in unadjusted incremental total healthcare expenditures among individuals with arthritis in 2011, 2012, and 2013, and a decline in 2014. Such trends remained with the adjusted incremental total healthcare expenditures. Similarly, a previous study by Cisternas, *et al* reported a nonsignificant increase in total healthcare expenditures (2014 US dollars) among individuals with arthritis from $9223 in 1997 to $10,578 in 2005[4]. Further, for expenditures by types of services, the order of top 3 categories was outpatient, inpatient, and prescription drugs in 2008, which is similar to that reported by Cisternas, *et al*[4]. In 2005, however, we noted a shift in top 3 categories in 2014 to outpatient, prescription drugs, and inpatient services. There could be many plausible explanations for these trends.

First, it is highly likely that the outpatient procedures such as orthopedic surgeries are becoming a common management option for arthritis. In fact, literature on outpatient surgical procedures suggests an increase in uptake of outpatient orthopedic surgeries such as knee or hip arthroplasty in the US from 1995 to 2005[23]. Further, outpatient medication services also include the administration of injectable medications such as biologics. Because biologics are administered as a part of outpatient medication services, the use of outpatient services may have been sustained over a period of time as a management approach among individuals with arthritis.

Second, prescription drug expenditures were also sustained and grew marginally over 2008 to 2014. After the Medicare Part D era, affordability to prescription drugs and off-patent prescription drugs (generics) could have led to improved access, reflecting a relatively stable prescription drug expenditure throughout 2008 to 2014. For example, a study by Polinksi, *et al* found an increase in biologics use among Medicare beneficiaries with rheumatoid arthritis after the Part D Medicare coverage, and a decline in OOP expenditures with cost sharing[24]. Our study also noted a decline in

unadjusted OOP expenditures from 2008 to 2014, mainly driven through decline in prescription drug OOP (Supplementary Table 3, available with the online version of this article).

Third, we found relatively stable unadjusted and adjusted inpatient expenditures from 2008 to 2013, with a decline specifically in 2014. Our findings are consistent with studies assessing the effect of the Affordable Care Act, such as introduction of the Hospital Readmission Reduction Program. Starting in October 2012, hospitals with excessive 30-day readmissions and hospital-acquired infection-related hospitalizations were penalized. Studies have shown a decline in 30-day readmission rate from 19.0% to 18.0% among Medicare beneficiaries, and 17% decline in hospital-acquired conditions from 2010 to 2013[25]. In our study, we also noted a decline in inpatient hospitalization from 15% in 2008 to 13% in 2014 (Supplementary Figure 1, available with the online version of this article), and observed a decline in the magnitude of incremental healthcare expenditures.

Last, we noted increasing trends in aggregate expenditures for the population of arthritis from $584.8 billion in 2008 to $645 billion in 2014. Total aggregate healthcare expenditures for individuals with arthritis accounted for about 4.0% of the US gross domestic product in 2008 and 2014. The increase in aggregate unadjusted total direct healthcare expenditures was mainly driven through an increase in weighted population of individuals with arthritis. On a positive side, we noted a slowdown in the intensity of adjusted incremental expenditures and OOP specifically from 2013, which led to a huge decline in the aggregate direct healthcare expenditures in 2014.

Our study provides substantially crucial and up-to-date information about total and OOP expenditures among individuals with arthritis in the US using the recently available nationally representative MEPS data. A robust and widely used method of addressing the issue of zero expenditures and skewed expenditure data to provide robust estimates of healthcare expenditures was used in the analyses. However, there are a few limitations worth noting. Because the MEPS data are based on self-reported data, treated prevalence of arthritis and other chronic conditions may affect estimates; however, prevalence of arthritis using self-reported data from MEPS has been consistent with the estimates obtained from the other survey data[17]. Our study estimates have not included indirect expenditures. Arthritis is also prevalent among individuals residing in nursing homes, but because the MEPS covers non-institutionalized individuals, our findings cannot be generalizable to institutionalized individuals with arthritis. Disease progression and severity, and types of medications under outpatient services, cannot be collected using the MEPS data.

Our study quantifies incremental healthcare expenditures among individuals with arthritis compared to those without arthritis in the US and provides crucial information to providers, payers, and policy makers on how the dollar amount is being spent in treating patients with arthritis.

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ONLINE SUPPLEMENT

Supplementary material accompanies the online version of this article.

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