

Evaluating the economic burden of psoriasis in the United States

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Background: Psoriasis has significant economic impact on patients. However, its total economic burden has not been fully quantified.

Objectives: To assess the annual economic burden of psoriasis in the United States.

Methods: A systematic literature review was conducted to obtain estimates of the components of the economic burden of psoriasis. Prevalence estimates were used to estimate the 2013 psoriasis population. Incremental medical costs were calculated based on studies that compared psoriasis patients and controls. Productivity loss was estimated using measures of presenteeism, absenteeism, and unemployment. Reductions in health-related quality of life (HRQOL) were calculated from survey responses.

Results: The prevalence of psoriasis in the US was estimated to be 7.4 million in 2013. Comparatively, psoriasis patients incurred incremental medical costs of \$2284, experienced a \$2203 reduction in HRQOL, and a \$1935 reduction in productivity. The total burden of psoriasis was estimated as \$35.2 billion, with \$12.2 billion in incremental medical costs (35%), \$11.8 billion from reduced HRQOL (34%), and \$11.2 billion from productivity losses (32%).

Limitations: This study is constrained by the scope and populations of the existing literature.

Conclusions: The economic burden of psoriasis in the US is significant, with a majority of it coming from indirect costs. (J Am Acad Dermatol 2015;72:961-7.)

Key words: disease burden; economic burden; presenteeism; prevalence; psoriasis; systematic review.

Psoriasis is a chronic, immune-mediated skin disease that affects approximately 2% to 3% of the population of the United States.^{1,2} While psoriasis is usually not life-threatening, patients can incur lifelong costs because of the chronic nature of the condition. In addition to the direct medical costs incurred to treat the disease, psoriasis patients often suffer from loss of work productivity, medical leave of absence, work force dropout, or lower wage trajectories.³⁻⁵ Moreover, patients may

Abbreviations used:

CPI:	Consumer Price Index
ER:	emergency room
HRQOL:	health-related quality of life
QALY:	quality-adjusted life year
SF-12:	Short-Form Health Survey 12

experience reduced quality of life (QOL) from psoriasis-related discomfort or disability⁶⁻⁸ or face stigma in social settings.^{4,5,9-12}

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Appendices and Table A1 are available at <http://www.jaad.org>.

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Several studies have addressed components of the total burden and indicated significant costs both in and away from the workplace.³⁻⁵ The most recent annual burden estimate of \$11.3 billion, provided by the National Psoriasis Foundation, is based on a study from 2008 and does not include some aspects of medical care, productivity losses, and the implications of psoriasis on quality of life.³

A better understanding of the total burden imposed by psoriasis is essential to determine the cost-effectiveness and value of new and existing psoriasis treatments and valuing investments in future treatment options. This study estimated the total economic burden of psoriasis in the US by combining estimates from the literature on the incremental health care costs of psoriasis, the effects on productivity and QOL, and estimates of incidence and prevalence of psoriasis.

METHODS

Systematic literature review

A comprehensive literature search was conducted to identify peer-reviewed articles published between January 2003 and June 2013 that examined components of the clinical, economic, and/or social burden of psoriasis in the US. The inclusion and exclusion criteria for selecting articles were determined a priori based on the *population, interventions, comparators, outcomes, timing, and setting* (PICOTS) framework (Tables I and II). Based on the sociodemographic definitions of the cohorts included in the literature, this study estimated the total economic burden of psoriasis among the US adult population (ie, ≥ 18 years of age), across all racial and gender groups.

Outcomes

The total costs of psoriasis were estimated from the societal perspective, and all dollar estimates reported were adjusted to 2013 US dollars using the medical care component of the Consumer Price Index (CPI)—a measure of changes in the price level provided by the Bureau of Labor Statistics. Based on the availability of data, this review focused on the following burden components.

Disease burden. Disease burden is often measured by prevalence rate (ie, the count of existing cases in a given period of time and place)

or by incidence rate (ie, the count of new cases over a period of time or person-years). The initial review identified 4 articles published in the past 10 years that reported prevalence of psoriasis among adults in the US, with the latest estimates for 2003 and 2004. Several papers were further identified that contained more recent (and more conservative) prevalence

estimates, suggesting prevalence rate between 0.95% to 3.2% for the US population ≥ 18 years of age.^{2,13-15} Lebwohl et al² report a rate of 2.2%, which is in the middle of the estimated range, so this rate was used as the basis for the estimates of total national burden.

Incremental medical costs. Direct costs of disease are often calculated from insurer expenses and out of pocket expenses for treatment-related services such as inpatient, outpatient, emergency room (ER) visits, and pharmacy. Only articles

that compared per-person costs between psoriasis and nonpsoriasis patients (controls) were included to determine the incremental cost related to psoriasis. In some articles, these costs were broken down by service type or disease severity, and this breakdown was used to produce severity-specific estimates of burden.

Incremental costs were converted to 2013 dollar values and then multiplied by the derived estimate of 2013 psoriasis cases to determine the incremental health insurance expenses, patient out of pocket costs, and total medical costs.

Productivity loss. Productivity loss is commonly estimated using measures of presenteeism, absenteeism, and unemployment. Taken together, these concepts measure productivity lost while at work, while absent from work, and while unable to be employed. In other words, these 3 outcomes represent a mutually exclusive and exhaustive scope of the total productivity loss to both the patient and society. Estimates for the respective components derived from the literature were multiplied by the prevalent population to calculate the national level burden, and then aggregated to derive the total psoriasis-related productivity cost in the US (see Appendix A for additional details).

Quality of life. Reduction in health-related QOL (HRQOL) because of psoriasis is an important component of the overall disease burden.

CAPSULE SUMMARY

- Psoriasis has significant economic impact; however, previous studies have not considered important components of cost.
- This study estimated that in the United States, the total annual economic burden of psoriasis from treatment, lost productivity, and reduced quality of life was \$35.2 billion in 2013, with most coming from indirect costs.
- Clinicians should consider the economic burden of psoriasis when assessing the cost-effectiveness of treatment.

Table I. Study inclusion criteria based the PICOTS framework

Population	Adult (≥ 18 years of age) psoriasis patients; includes patients with mild, moderate, or severe psoriasis; includes patients with psoriatic arthritis
Interventions	Not applicable
Comparators	Not applicable
Outcomes	Disease burden: prevalence, incidence, psoriasis-related comorbidities; economic burden includes indirect costs (ie, productivity loss, disability burden, quality of life, mental health effects, social stigma, and caregiver burden) and direct costs (out of pocket costs and health care utilization)
Timing	January 2003 to June 2013 (publication years)
Setting	United States (place where study was conducted)

Table II. Exclusion criteria for systematic review

Study does not include human subjects
Study design is a clinical trial or randomized controlled trial
Study is published in a non-English language
Study is not an original research study (eg, reviews, letters, editorials, opinions, comments, or newspaper articles)

Published information on the monetary values for impaired HRQOL was very limited.¹⁶ Therefore, the estimated HRQOL burden was imputed based on the difference in scores from Short-Form Health Survey 12 (SF-12) for a psoriasis group and a control group. SF-12 scores have been mapped to quality-adjusted life year (QALY) utility weights,¹⁷ allowing the cost of reduced HRQOL to be estimated using the difference in QALY utility weights and a conservative QALY value of \$40,000—the US equivalent of the lower-bound of the National Institute of Health and Care Excellence QALY range values (£20,000-30,000; see [Appendix B](#) for a detailed description).

Total economic burden. The per-patient annual average costs related to psoriasis were multiplied by the estimated total psoriasis cases in 2013, and then aggregated to estimate the total economic burden in the US.

RESULTS

A total of 3692 unique titles were collected from the broad database searches. Careful examination yielded 91 articles that were included for data extraction. A detailed review of the screening process is laid out in [Fig 1](#) (see also [Appendix C](#)). In the final list of articles, 74% of the studies examined adults ≥ 18 years of age and were considered in our burden estimates, while the remainder focused on children or did not report the age range of the sample and were therefore not used in the estimation.

Disease burden

[Table III](#) summarizes the prevalence estimates found in the review. Based on these estimates, about

5.3 million people were living with psoriasis in the US at the beginning of 2013. Of these, the majority were white (88.1%) and had a mild form of the disease (83.3%).

Health care costs

[Table IV](#) summarizes the estimates of per-patient annual average incremental medical costs that were used to calculate the total health care costs related to psoriasis. We estimated the incremental per patient health care cost to payers to be \$1757 annually, which was the average of the estimates of Yu et al¹² and Gunnarsson et al.¹⁸ To estimate incremental total costs, we also incorporated the estimated average incremental out of pocket costs of \$527 per year from Gunnarsson et al.¹⁸

[Table IV](#) also shows the annual average per-patient incremental costs by type of service, including inpatient, outpatient, emergency care, and pharmacy costs that were estimated based on information from Yu et al¹² and Han et al.¹⁹ On average, psoriasis patients incurred higher annual incremental costs in outpatient and pharmacy (medical prescription) services (\$952 and \$948, respectively) compared to inpatient (\$433) or emergency care (\$25). When stratified by disease severity, this pattern of higher costs for outpatient and pharmacy services persisted among mild disease cases; however, for patients with moderate to severe cases, pharmacy costs alone dominated all other costs. Stratifying by severity also revealed that patients with mild psoriasis incurred notably lower costs (outpatient: \$781; pharmacy: \$559; inpatient: \$382; ER: \$23) than patients with moderate to severe disease (outpatient: \$2274; pharmacy: \$5807; inpatient: \$909; ER: \$51^{12,19}). (Note that there are over the counter topical medications available to treat mild to moderate psoriasis that are not included in the claims pharmacy data. These estimates should therefore be viewed as conservative estimates of total pharmacy costs.) Han et al¹⁹ reported a similar pattern of average incremental

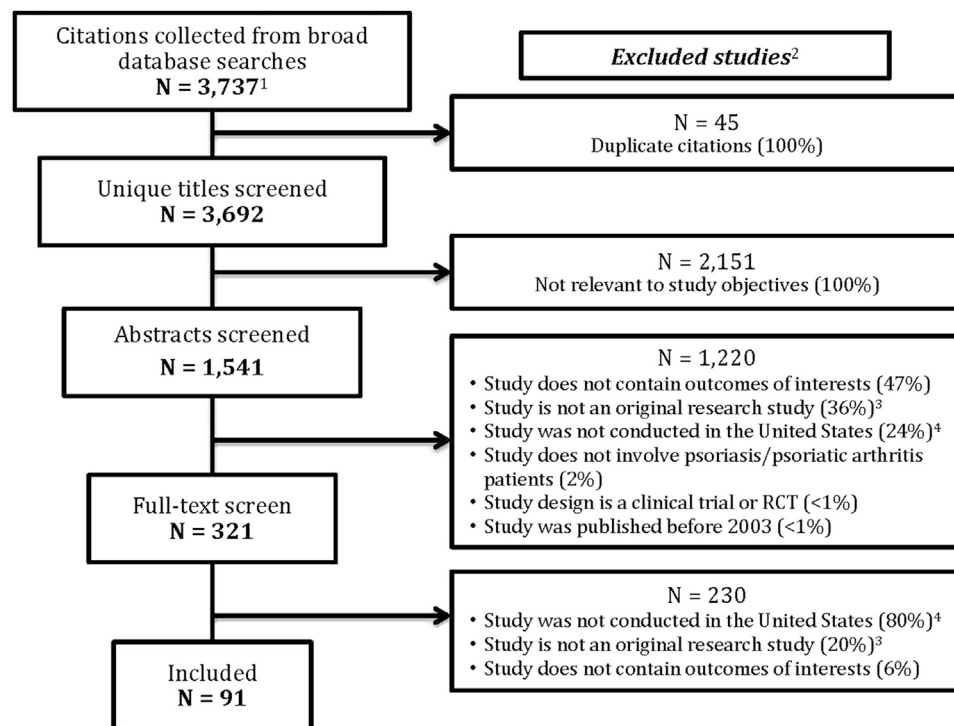


Fig 1. Psoriasis study flow diagram. ¹PubMed yield = 3663; Cochrane yield = 74. ²Percentages are calculated using excluded studies in each level as the denominator. ³Systematic reviews flagged for hand-screening citations: 58 in the abstract screen, 3 in the full-text screen. ⁴Non-US studies flagged for further investigation if necessary: 261 in the abstract screen, 166 in the full-text screen.

costs among patients with moderate to severe disease (outpatient: \$1927; pharmacy: \$6873; inpatient: \$877; emergency room: \$57).

The higher pharmacy costs in the later study could reflect the increased use of biologic medications in treating psoriasis. According to a survey conducted in 2012, about 11% of patients are either currently using biologics or have previously used them, and 55% of these patients are still current users.² Biologics are more expensive than older, small-molecule drugs.

Productivity loss. Productivity loss is commonly estimated using measures of presenteeism, absenteeism, and unemployment; however, these measures fail to account for the indirect costs associated with some other aspects of lost productivity, such as the potential lack of advancement in the workplace. We were unable to find any estimate of the effect psoriasis has on this later cost, so it was not included in the analysis.

Using Schmitt and Ford⁴ and Allen et al,²⁰ we estimated the productivity loss related to presenteeism at \$4.4 billion annually. With regards to absenteeism, Allen et al²⁰ estimated that psoriasis patients miss 1.26% more days of work than patients without psoriasis, implying a cost of \$2.9 billion annually.

Pearce et al²¹ found that about 16.7% of unemployed psoriasis patients were actually unemployed because of psoriasis. This rate was applied to the more robust estimate of unemployment among psoriasis patients provided by Ciocon, Horn, and Kimball,²² resulting in an estimate of annual productivity loss of about \$700 per patient and a total of \$4.0 billion because of unemployment.

Combining these estimates puts the total aggregated productivity losses caused by psoriasis at \$11.2 billion (Table V; Appendix A and Table A1).

Quality of life: Mental and physical health effects. To estimate the impact of psoriasis on QOL, data were extracted from 16 articles that measured HRQOL in psoriasis patients using >7 different instruments (Appendix B). Although all of these studies suggest that psoriasis has a significant impact on HRQOL, this analysis relied on the Short Form-12 scores for psoriasis patients reported by Allen, Bunn, and Naim²⁰ and Grozdev et al²³ and estimated a \$2203 reduction in HRQOL per-patient annually or about \$11.8 billion in total.

Other burden components. Patients with psoriasis also report facing stigma and disability burden, particularly among those who develop psoriatic arthritis. We found 2 studies that explored social

Table III. Estimate* of prevalence of cases of psoriasis among adults (≥18 of age) in the United States (2013)

Population	Estimated number of prevalence cases (in millions)	Percent of US population	Percent of total psoriasis population
Total US population	242.56	100.00	—
Total psoriasis cases	5.34	2.20	100.00
By psoriasis severity			
Mild	4.44	1.83	83.27
Moderate	0.61	0.25	11.43
Severe	0.28	0.12	5.30
By sex			
Male	2.59	1.07	48.61
Female	2.74	1.13	51.39
By race/ethnicity			
White	4.70	1.94	87.99
Nonwhite	0.64	0.26	12.00

*Based on the prevalence and incidence rates reported by Lebwohl et al² and Stern et al,⁶ respectively. The total US population was estimated at 242,556,624 based on the Census population clock on November 5, 2013.

stigma or discomfort faced by psoriasis patients ≥18 years of age: 1 study each on disability burden and caregiver burden. However, these studies reported measures that could not be quantified in dollar values per psoriasis patient.

Finally, a number of studies examined the elevated risk of comorbidities among psoriasis patients; however, to be conservative, the incremental costs for comorbidities were not reported separately because the total health care costs reported by the studies included in this review were not restricted to psoriasis-related medical expenses.

Total economic burden

Table VI reports the estimated total and per-patient economic burden in 2013 for the prevalent population. The annual per-patient total cost for each component was \$2092 for lost productivity, \$2203 for reduced QOL, and \$2284 for incremental medical costs, for a total per-patient psoriasis burden of \$6579. The annual cost for each burden component at the national level was \$11.2, \$11.8, and \$12.2 billion for productivity, QOL, and medical costs, respectively. The total estimated annual cost of psoriasis was \$35.2 billion in 2013 dollars.

DISCUSSION

This study provides the first comprehensive estimate of the total burden of psoriasis and disaggregates this estimate into direct incremental

Table IV. Estimates of per-patient annual average incremental medical costs among psoriasis patients ≥18 years of age in the United States (2013)

Health care cost*	Psoriasis severity status		
	Overall	Mild	Moderate to severe
Total cost (\$)†			
Total health care costs from payer	1757‡	1820§	9733‡
Total out of pocket costs	527§		
By type of service (\$)¶			
Total inpatient cost	433§	382§	909‡
Total outpatient cost	952§	781§	2274‡
Total emergency department cost	25§	23§	51‡
Total pharmacy cost	948§	559§	5807‡

*All dollar values were inflated to reflect the 2013 US dollar values using the medical care component of the Consumer Price Index.

†From Yu et al,¹² Han et al,¹⁹ and Gunnarsson et al.¹⁸ The overall estimate for health care costs from the payer of \$1757 is outside of the range of the mild and moderate to severe estimates because it was derived as an average across 2 studies. The 2 studies suggest that overall incremental costs fall in the range of \$1042 to \$2388.

‡Based on estimates from 2 studies.

§Based on estimates from 1 study.

¶From Yu et al¹² and Han et al.¹⁹

medical costs, reduction in QOL, and productivity losses. The study findings suggest that the total annual economic burden of psoriasis in the US was \$35.2 billion in 2013; of this, \$12.2 billion (35%) came from direct costs while \$23 billion (65%) came from indirect costs, such as productivity and HRQOL losses. The large indirect costs observed among psoriasis patients is not surprising given that psoriasis may have a greater daily physical and mental impact on patients than other conditions typically associated with higher medical costs, such as diabetes. It also highlights how studies that only examined the direct medical costs associated with psoriasis greatly underestimated the true economic burden of the disease.

The estimate of \$35.2 billion is smaller than some similar estimates made for the psoriasis population in previous work. For example, Fowler et al³ provided a burden of psoriasis that translates to about \$50.1 billion in 2012 dollars. This difference is noteworthy because their burden estimate included only insurer expenditures and absenteeism costs, ignoring the additional costs presented here. In addition, they did not include costs related to emergency care, out of pocket payments, diminished QOL, presenteeism, or unemployment.³

The total medical costs of psoriasis estimated in this study are small compared with burden estimates observed for other chronic diseases.^{18,24}

Table V. Estimates of quality of life and productivity costs among psoriasis patients ≥ 18 years of age in the United States (2013)

	\$/yr/patient	Total \$/yr (in billions)
Quality of life		
Mental and physical health* [†]	2203	11.8
Productivity		
Presenteeism* [‡]	815	4.4
Absenteeism* [§]	535	2.9
Unemployment [¶]	741	4.0

Note: Prevalent population from the 2013 estimates calculated in this review was applied to estimate total annual costs.

*Based on estimates from 2 studies.

[†]Calculated using Short Form-12 Health Survey results from Grozdev et al²³ and Allen et al,²⁰ a QALY value of \$40,000 and QALY utility weights calculated using a method developed by Sullivan and Ghushchyan.¹⁷

^{‡§}Estimated costs were from Allen et al²⁰ and the methodology was adapted from Schmitt and Ford.⁴

^{||}Based on estimates from 1 study.

[¶]Estimated costs were based on Ciocon, Horn, and Kimball²² and Pearce et al.²¹

For example, diabetes, a chronic disease afflicting approximately 22.3 million people in the US. Incurred an estimated \$176 billion of incremental health care costs in 2012 (about \$7900 per person annually) according to a newly released study by American Diabetes Association.²⁴ However, with increasing fiscal pressure and insurance expansions under the Affordable Care Act, the total incremental medical costs of \$12.2 billion per year for psoriasis represents a nontrivial impact on the health care system. Based on the estimates identified in this review, private and public insurers bear >75% of these costs^{12,18,19}—a total of approximately \$9.4 billion per year. In addition, compared to diabetes, a larger proportion of the total burden of psoriasis is related to either reduced productivity or diminished QOL.²⁴

A large component of the total burden of psoriasis is driven by indirect costs, but these costs are more difficult to measure and not always recognized by payers.²⁵ As noted above, the medical costs associated with treating psoriasis have risen in recent years, in part because of the cost of biologics. Biologics are associated with significant improvements in productivity and QOL,²⁶⁻²⁸ but some clinicians are concerned that the low insurance coverage for these drugs is preventing more widespread use.¹³ If more effective treatment generated offsets to the indirect costs of psoriasis that were large enough to outweigh the cost of the medication(s), then barriers to access to effective treatment options could actually increase the total

Table VI. Estimate of the total burden of psoriasis in the United States (2013)

	\$/yr/patient	Total \$/yr (in billions)
Total medical costs*		
Total health care costs from payer	1757	9.4
Total out of pocket costs	527	2.8
Total medical costs	2284	12.2
Quality of life		
Mental and physical health	2203	11.8
Productivity		
Presenteeism	815	4.4
Absenteeism	535	2.9
Unemployment	741	4.0
Total productivity costs	2092	11.2
Total psoriasis burden	6422	35.2

*Health care costs reflect the incremental cost of psoriasis.

economic burden of psoriasis. More generally, failing to recognize the large indirect and direct burden that psoriasis imposes on patients could cause society to undervalue treatments that could improve patient health, productivity, and QOL.

LIMITATIONS

Systematic reviews are constrained by the scope of the existing literature and the study population included in those studies, which can raise issues of generalizability when applying these estimates to the full population. In addition, the burden estimates did not include some of the indirect burden components, such as disability, social stigma, and caregiver burden.

CONCLUSIONS

We estimate a total of 5.34 million people living with psoriasis in the US in 2013, generating a total economic burden of \$35.2 billion at the national level. A little over one-third of these costs were associated with direct health care expenditures; a majority of psoriasis burden came from indirect costs resulting from reduced QOL and loss of productivity, which poses significant impact on patients, health care providers, and employers. Timely and effective treatment of psoriasis can impact these burdens, particularly the indirect costs—potentially reducing the substantial societal burden placed by psoriasis.

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APPENDIX A**Methodology for estimating components outcomes of interest**

Productivity loss. Based on the estimates available in the existing literature, the components of productivity loss attributable to psoriasis were estimated using the method explained below.

Presenteeism. Presenteeism measures the productivity lost while actually at work. The articles in our review estimated this loss using either the Work Productivity and Activity Impairment (WPAI) or the Work Limitations Questionnaire (WLQ) instrument. The WPAI instrument assesses employment and work productivity. The WLQ measures on the job impact of chronic conditions within the past 2 weeks using 4 domains of work demand—time, physical, output, and mental-interpersonal. The scores for the output demand domain were shown to do the best job of predicting actual productivity loss and have been validated against actual work productivity loss.⁴ This WLQ output demand scale (ODS) consists of an average score from 5 items included in the domain and measures the proportion of time in the past 2 weeks that a patient experienced limitations in successfully performing work within his or her normal ability. The scale ranges from 0% (not at all limited) to 100% (limited all the time). Schmitt and Ford⁴ show how to use the ODS, along with a previously estimated work productivity coefficient (WPC) and information on the unemployment rate among psoriasis patients (UR), the working-age population (WP), the disease

prevalence (P), and the average income (AI) to calculate the annual cost of presenteeism.¹ We applied their method to calculate a per person cost of presenteeism. Specifically, we used the following equation:

$$\text{Presenteeism cost/yr} = \text{ODS} * \text{WPC} * \text{AI} * \text{P} \\ * (\text{WP} * [1 - \text{UR}])$$

The unemployment rate in the psoriasis population was taken from Ciocon, Horn, and Kimball²² and the US working-age population for 2013 was calculated using census data from 2012 and applying the growth rate from 2011 to 2012. The 2013 psoriasis population was based on prevalence estimates calculated for this review, and the average annual income for 2013 was calculated using the US Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages for 2012 and applying the growth rate from 2011 to 2012.^{29,30} These data were also applied to estimate absenteeism and unemployment caused by psoriasis below as appropriate.

Absenteeism. Psoriasis can also reduce productivity by causing patients to be absent from work for some positive amount of time because of either physical or mental impairments or a doctor visit. Data on percent of workdays missed (WM) for medical reasons reported by Schmitt and Ford⁴ were used in combination with 2013 data on the unemployment rate among psoriasis patients, the average income information provided by BLS

Table A1. Estimating components of productivity cost

		Presenteeism	Absenteeism	Unemployment
[1]	Productivity loss score (1,2)	4.4%		
[2]	Actual work productivity declined (3)	45.0%		
[3]	Percent workdays missed for medical reasons (4)		1.3%	
[4]	Average annual income 2013 (5)	\$50,535	\$50,535	\$50,535
[5]	Psoriasis prevalence 2013 (6)	2.2%	2.2%	2.2%
[6]	US population 18-64 y, 2013 (7)	197,779,616	197,779,616	197,779,616
[7]	Psoriasis unemployment rate (8)	10.8%	10.8%	10.8%
[8]	Unemployment rate due to psoriasis (9)			1.8%
[9]	Total cost per year	\$5,366,330,650	\$3,414,937,687	\$5,480,088,985

[1] Represents the output demands component of the Work Limitations Questionnaire (WLQ) and indicates the percent of time in the previous 2 weeks that patients were limited in performing work demands. From Allen, Bunn and Naim 2012 (claims verified sample). Methodology adapted from Schmitt and Ford 2006. This study did not use a random sample; actual observations were not included.

[2] Represents the estimated coefficient for actual work productivity decline associated with the WLQ output demand score from Lerner et al.³²

[3] From Allen, Bunn, and Naim 2012 (claims verified sample).

[4] Calculated using the BLS Quarterly Census of Employment and Wages for 2012 and applying the growth rate from 2011-2012.

[5] From the estimate of 2013 prevalence cases (see Table III in the manuscript).

[6] Calculated using census data from 2012 and applying the growth rate from 2011-2012.

[7] From Ciocon, Horn, and Kimball 2008. We assume the unemployment rate for psoriasis patients has remained constant 2005-2013.

[8] Percent of unemployment related to psoriasis from Pearce et al 2006.

[9] Presenteeism cost per year = [1]*[2]*[4]*[5]*([6]*(1-[7])). Absenteeism cost per year = [3]*[4]*[5]*([6]*(1-[7])). Presenteeism cost per year = [4]*[5]*[6]*[8].

and the working-age psoriasis population to estimate the difference in cost related to absenteeism.^{4,30} Specifically, the following equation was applied:

$$\begin{aligned} &\text{Absenteeism cost/patient/yr} \\ &= \text{WM} * \text{AI} * \text{P} * (\text{WP} * [1 - \text{UR}]) \end{aligned}$$

Unemployment. Unemployment because of psoriasis is another source of lost productivity. One study by Pearce et al²¹ examined psoriasis-related unemployment status among 90 psoriasis patients with equal representation for mild, moderate, and severe psoriasis. Given that the patient sample in this study was skewed towards more severe cases, their underlying measure of the unemployment rate amongst psoriasis patients is likely biased. Therefore, their percent of unemployment because of psoriasis was applied to a more reliable estimate of unemployment rates among the psoriasis population reported by Ciocon, Horn, and Kimball²² to arrive at a more reliable psoriasis-related unemployment rate. Then, applying this rate to the estimated psoriasis population and using 2013 estimates of the average income and the working-age psoriasis population, the annual psoriasis-related productivity loss because of unemployment was calculated. Specifically, the following equation was used

$$\begin{aligned} &\text{Unemployment cost/yr} = \text{UR because of psoriasis} \\ &\quad * \text{P} * \text{WP} * \text{AL} \end{aligned}$$

APPENDIX B

Health-related quality of life measures

Reductions in health-related quality of life (HRQOL) caused by psoriasis is an important component of the overall disease burden—especially because psoriasis is a chronic disease that can result in uncomfortable and unsightly symptoms. However, HRQOL impacts are difficult to measure and quantify. It is a multidimensional concept that covers patients' physical, mental, emotional, and social functioning, all of which are likely impacted by psoriasis. In acknowledgement of the importance of HRQOL, hundreds of different general and disease-specific survey instruments have been developed to assess HRQOL. The most widely used instrument in practice is the Short Form (SF)-36,³¹ which is a multipurpose health survey containing 36 questions that provides an 8-scale profile of functional health and well-being scores as well as psychometrically-based physical and mental health summary measures. Over time, the SF-36 instrument has been developed into shorter questionnaires to limit the time and burden of responding. The SF-12 (12 questions instead of 36)

and SF-8 (8 questions) were used in some of the articles included in this review to measure HRQOL. Both short forms include physical and mental health summary measures.

In addition to the general HRQOL survey instruments, there are a number of disease-specific QOL surveys. These surveys assess the special states and concerns of various diagnostic groups and may therefore be more sensitive to small changes in QOL. In our review, we found 3 articles that used the Dermatology Life Quality Index (DLQI). This survey consists of 10 questions assessing symptoms and feelings, daily activities, leisure, work and school, personal relationships, and the effects of treatment on daily life within the past week. The DLQI score ranges from 0 to 30, with higher scores reflecting poorer HRQOL.

The challenge with HRQOL measures is translating scores into dollar amounts. With the exception of 1 study reporting hypothetical willingness to pay estimates,¹⁶ our review did not find any monetary values for HRQOL loss. Therefore, in order to estimate our own HRQOL burden estimates, we focused on those studies that used a representative sample of patients and compared instrument scores for a psoriasis patient group to those of a control (nonpsoriasis) group. We then looked for previously published algorithms that calculated utility weights that could be applied to quality of life year (QALY) values. Both the SF-36 and the SF-12 have been mapped to QALY utility weights; however, the SF-36 mapping requires more detailed score breakdowns than were available in our articles. Instead, we focused on the SF-12 mapping. We used the mental and physical component SF-12 scores reported in Grozdev et al²³ and applied an algorithm developed by Sullivan and Ghushchyan¹⁷ to calculate QALY utility weights. Using a conservative QALY value of \$40,000 (The National Institute of Health and Care Excellence [NICE] values a QALY at £20,000-30,000; £20,000 ≈ \$40,000) we then estimated the reduction in HRQOL caused by psoriasis per patient annually by multiplying the QALY value by the utility weights for both the control group and the psoriasis patients and calculating the difference. Allen, Bunn, and Naim²⁰ also report SF-12 scores along with the associated utility weights. Using the same method above, we calculated another estimate of the reduction in HRQOL caused by psoriasis. We averaged these 2 estimates to arrive at the final per-patient annual cost of reduced HRQOL. The US-wide burden of reduced HRQOL was finally estimated by multiplying the estimate per-patient cost and total population of psoriasis.

APPENDIX C

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