Dermatol Ther (Heidelb)
https://doi.org/10.1007/s13555-025-01349-7

ORIGINAL RESEARCH

# Healthcare Resource Utilization and Economic Burden of Prurigo Nodularis in the United States

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Received: July 16, 2024 / Accepted: September 30, 2024


## ABSTRACT

***Introduction*:** The impacts of prurigo nodularis (PN) on healthcare resource utilization (HCRU) and associated costs are unclear.
***Methods*:** This retrospective, cross-sectional claims analysis (IQVIA PharMetrics® Plus) compared HCRU and costs over 1 year in adults with PN versus matched controls (region, payer type, age, sex, year) from 2016 to 2019, and also in patients with PN receiving advanced versus localized/no therapy. For patients with data in multiple calendar years, 1 year was randomly selected. Outcomes were compared by chi-square tests, *t* tests, or negative binomial tests.
***Results*:** We matched 16,888 patients with PN with 16,888 controls. Most comorbidities (mental health, metabolic conditions, type 2 inflammatory diseases) appeared more frequently in patients with PN versus controls. HCRU was significantly ($P<0.001$) higher for patients with PN versus controls, including mean (standard deviation, SD) number of outpatient visits (17.0 [15.5] vs 8.1 [10.7]) and proportion of patients with hospitalizations (9.3% vs 5.9%). Mean (SD) total costs were significantly ($P<0.001$) greater for patients with PN versus controls ($18,315 [$66,476] vs $8451 [$30,982]).
***Conclusions*:** Patients with PN receiving advanced therapy had higher HCRU and costs versus localized/no therapy. Patients with PN (particularly those receiving advanced therapies) incurred higher all-cause HCRU burden and associated costs than matched controls.

**Keywords:** Claims analysis; Healthcare resource utilization; Prurigo nodularis

**Supplementary Information** The online version contains supplementary material available at https://doi.org/10.1007/s13555-025-01349-7.

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Published online: 08 February 2025

**Key Summary Points**

The impacts of prurigo nodularis (PN) on healthcare resource utilization (HCRU) and associated costs are unclear.

This study aimed to estimate HCRU and costs associated with PN compared with matched controls using a large US health plan claims database, and to compare costs and HCRU among patients with PN, stratified by whether or not they received advanced therapy, as a proxy for disease severity.

Patients with PN had higher HCRU and costs than matched controls, which was primarily driven by outpatient services.

Patients with PN receiving advanced therapies had the highest HCRU and costs, which were also mostly due to outpatient services, suggesting that the burden of PN may rise with increasing disease severity.

## DIGITAL FEATURES

This article is published with digital features, a video abstract, to facilitate understanding of the article. To view digital features for this article go to https://doi.org/10.6084/m9.figshare.27645837.

## INTRODUCTION

Prurigo nodularis (PN) is a chronic pruritic disorder that presents with a history of intense itching lasting ≥ 6 weeks, and with multiple intensely itchy, firm, and elevated skin nodules that are usually distributed on the limbs and trunk in a symmetrical pattern [1, 2]. PN is a relatively rare condition, and prevalence in the USA was estimated as 70 per 100,000 adults in a claims database study [3]. PN predominantly affects individuals in their fifties, and women are more likely to have PN than men [4]. There is a disproportionately high incidence of PN among Black patients and their all-cause mortality is higher than White, Hispanic, and Asian patients with PN [5]. Compared with those without PN, patients with PN have a higher incidence of systemic and psychological comorbidities, such as HIV infection, non-Hodgkin lymphoma, chronic kidney disease, obesity, hypertension, heart failure, cerebrovascular disease, coronary heart disease, chronic obstructive pulmonary disease, eating disorders, attention-deficit/hyperactivity disorder, schizophrenia, mood disorders, anxiety, and substance use disorders [4]. The precise pathology of PN remains unclear, but involves type 2 inflammatory pathways [6] and is associated with other type 2 inflammatory diseases, including asthma and atopic dermatitis (AD) [4].

Treatment goals for PN are broadly to reduce pruritus, interrupt the itch–scratch cycle, and heal PN lesions. In 2022, dupilumab was the first biologic treatment for PN to be approved by the US Food and Drug Administration [7]. Before dupilumab approval, most treatments for PN were used off-label and included localized and systemic treatments that target both neurological and immunological pathways [8]. Recently, another biologic therapy has been approved in the USA for treatment of PN, nemolizumab [9].

Patients with PN incur a large healthcare resource utilization (HCRU) burden. Annually, there are an estimated 13 visits due to PN per 100,000 outpatient visits in the USA, and PN accounts for more than 100,000 ambulatory visits per year [10]. In a study assessing claims data from October 2015 to December 2016, patients with PN were more than 30 times as likely to have an incident encounter with a dermatologist, compared with a matched control population without PN [11]. Patients with PN accounted for 3.7 inpatient visits per 100,000 discharges in the USA in 2016; compared with patients without PN, those with PN had significantly longer hospital stays and higher costs of care [12]. These increased costs with PN have also been demonstrated in other studies; mean total health care spending for patients with PN over 15 months was over $8300 per patient in a 2020 claims-based analysis [11]. This was predominantly due to outpatient costs, followed by inpatient, emergency department, and pharmacy/laboratory costs [11]. Patients with PN also face a high individual economic loss (based on

estimation of lost quality-adjusted life-years), which is estimated to be $323,000 over their lifetime [13].

No studies have assessed the full economic impact of PN from a payer perspective or explored how cost and HCRU vary by PN severity in the USA, despite these factors contributing to a significant disease burden. This study aimed to estimate HCRU and costs associated with PN compared with matched controls using a large US health plan claims database, and to compare costs and HCRU among patients with PN, stratified by whether or not they received advanced therapy, as a proxy for disease severity.

## METHODS

### Data Source

This retrospective cross-sectional study used data from the IQVIA PharMetrics® Plus database of US adjudicated medical and pharmacy claims, including patient enrollment data. The PharMetrics® Plus database includes data from more than 200 million enrollees since 2006 and represents all geographic areas of the USA. The database includes key demographic characteristics, inpatient and outpatient diagnoses and procedures, outpatient prescriptions, and costs paid by healthcare plans to providers. Data are compliant with the patient confidentiality requirements of the Health Insurance Portability and Accountability Act (HIPAA). This study examined HCRU and costs among patients with PN and matched patients without PN. All data in IQVIA PharMetrics® Plus datasets are HIPPA (1996) compliant and deidentified to adhere with all relevant US regulations and privacy laws. As such, this study only analyzed deidentified data, which are a priori exempt from Institutional Review Board approval according to the Federal Policy for the Protection of Human Subjects "Common Rule" (1991, revised 2018).

### Populations

Adults (aged ≥ 18 years) with PN were included if they had at least one inpatient or at least two outpatient medical claims containing a diagnosis code for PN (International Classification of Diseases, 10th Revision, Clinical Modification code L28.1) in any calendar year from 2016 to 2019. Patients were excluded if they were not continuously enrolled in the database for the calendar year of their inclusion. If patients with PN had at least one calendar year that was eligible for the study, 1 year was randomly selected for inclusion. Four annual cohorts were identified and combined to an overall cohort.

A matched-control cohort of patients without PN was identified from a 2% random selection of commercially insured enrollees in the IQVIA PharMetrics® Plus database who were matched with a patient with PN on a 1:1 ratio by region (Midwest, South, Northeast, and West), payer type (commercial vs Medicare), age (in the calendar year patients were identified), sex, and calendar year of inclusion (patients required to be continually enrolled for the calendar year of their inclusion). Patients selected for inclusion in the control cohort had no diagnosis code for PN in their calendar year of inclusion, but otherwise inclusion requirements were the same as for the PN cohort. The control cohort served as a reference cohort that described healthcare use and costs for a typical patient without PN.

Identified patients with PN were further stratified into two therapy cohorts: those who received advanced therapy during the year of inclusion and those who received localized or no therapy during the year of inclusion. Advanced therapies were systemic steroids (at least two prescriptions/claims for systemic steroids in the calendar year at least 30 days apart), systemic immunomodulators (methotrexate, azathioprine, mycophenolate, mofetil, and cyclosporine), thalidomide and thalidomide derivatives (thalidomide and lenalidomide), monoclonal antibodies (dupilumab), phototherapy (ultraviolet B and psoralens-ultraviolet A), gamma-aminobutyric acid receptor agents (pregabalin and gabapentin), and opioid receptor agents (naltrexone and butorphanol). Localized therapies included topical steroids, intralesional steroids, calcipotriene, topical doxepin, and calcineurin inhibitors.

### Outcomes

All-cause HCRU was measured over the year of inclusion and reported as mean number of events per patient for outpatient physician and dermatologist office visits, count and frequency (%) of patients with at least one inpatient hospitalization and emergency department visit, and mean inpatient length of stay (days). Healthcare costs assessed included those relating to hospitalizations, outpatient services, emergency department visits, pharmacy claims, and total healthcare costs (inclusive of hospitalizations, outpatient and emergency department visits, laboratory tests, diagnostics, and pharmacy). All costs were adjusted to 2019 US dollars based on the medical care component of the Consumer Price Index.

### Statistical Analysis

Patient characteristics were reported for the combined (2016–2019) cohort, stratified by patients with PN and controls. Patient demographics and clinical characteristics, including age, sex, insurance type, geographic region, provider specialty (defined as the provider with the largest number of office visits during the calendar year of inclusion), CCI score, and selected comorbidities: mental health (depression, anxiety, and insomnia), metabolic conditions (diabetes type 2, chronic kidney disease, congestive heart failure, myocardial infarction, and cerebrovascular accident), and type 2 inflammatory diseases (asthma, AD, chronic rhinosinusitis with nasal polyps, chronic rhinosinusitis without nasal polyps, food allergy, and eosinophilic esophagitis) for the specific calendar year were recorded. Prevalence ratios and 95% CIs were calculated for select comorbidities. HCRU, select comorbidities, and costs were reported for patients with PN vs controls and between patients with PN who received advanced vs localized/no therapy using means (SDs) for continuous data and counts/frequencies for categorical data. Chi-square tests for categorical variables (proportions of patients with any emergency department visit or hospitalization), *t* tests for continuous variables (mean number of outpatient physician office visits and dermatologist visits, mean length of stay among inpatients, and all-cause healthcare costs, except for costs associated with hospitalizations and emergency department visits), or negative binomial tests for mean number of inpatient hospitalizations and emergency department visits were used to compare patients with PN vs controls and advanced versus localized/no therapy. The costs associated with inpatient hospitalizations and emergency department visits are zero-inflated data; therefore, a marginalized two-part model with logistic regression for zero vs nonzero costs and a gamma regression model for nonzero costs were used to compare the crude, unadjusted inpatient and emergency department costs. Regression analyses for all-cause healthcare costs were performed to calculate adjusted costs for the differences in select comorbidities between patients with PN versus controls and the advanced versus localized/no therapy cohorts. The regression analyses adjusted for comorbidities that were not clearly related to PN (malignancy, Crohn's disease, ulcerative colitis, HIV, and psoriasis) and varied significantly between groups and for which high-cost treatments were likely. When comparing patients with PN receiving advanced versus localized/no therapy, the regression analyses were also adjusted for age group and sex, as these cohorts were not matched.

## RESULTS

### Populations

The study population comprised 16,888 unique patients with PN, who were matched 1:1 to a cohort of control patients without PN (Table 1). Included patients appeared to be evenly distributed across study years (2016–2019; Supplementary Table S1). The PN cohort and matched controls had a mean (SD) age of 54.5 (13.2), 54.8% were female, and the majority had commercial insurance (53.8%). Patients with PN had higher mean (SD) Charlson Comorbidity Index (CCI) score compared with the control cohort (1.2 [2.0] vs 0.7 [1.5]). Most comorbid

**Table 1** Patient demographics and clinical characteristics for patients with PN and matched controls and subgroups of patients with PN receiving advanced versus localized/no therapy

| Characteristic | Patients with PN (*N* = 16,888) | Controls (*N* = 16,888) | Patients with PN receiving advanced therapy[a] (*n* = 7103) | Patients with PN receiving localized/no therapy[a] (*n* = 9785) |
|---|---|---|---|---|
| Age, mean (SD), years | 54.5 (13.2) | 54.5 (13.2) | 54.9 (12.4) | 54.2 (13.7) |
| Female, *n* (%) | 9251 (54.8) | 9251 (54.8) | 4204 (59.2) | 5047 (51.6) |
| Region, *n* (%) | | | | |
| Midwest | 3963 (23.5) | 3963 (23.5) | 1661 (23.4) | 2302 (23.5) |
| Northeast | 2603 (15.4) | 2603 (15.4) | 1015 (14.3) | 1588 (16.2) |
| South | 7704 (45.6) | 7704 (45.6) | 3406 (48.0) | 4298 (43.9) |
| West | 2618 (15.5) | 2618 (15.5) | 1021 (14.4) | 1597 (16.3) |
| Payer type, *n* (%) | | | | |
| Commercial | 9083 (53.8) | 9083 (53.8) | 3890 (54.8) | 5193 (53.1) |
| Medicaid | 342 (2.0) | 342 (2.0) | 160 (2.3) | 182 (1.9) |
| Medicare[b] | 2230 (13.2) | 2230 (13.2) | 881 (12.4) | 1349 (13.8) |
| Other[c] | 5233 (31.0) | 5233 (31.0) | 2172 (30.6) | 3061 (31.3) |
| Provider specialty,[d] *n* (%) | | | | |
| Dermatologist | 4542 (26.9) | 618 (3.7) | 1759 (24.8) | 2783 (28.4) |
| PCP | 3142 (18.6) | 4739 (28.1) | 1361 (19.2) | 1781 (18.2) |
| PA/NP | 647 (3.8) | 470 (2.8) | 273 (3.8) | 374 (3.8) |
| Other | 6640 (39.3) | 6776 (40.1) | 2995 (42.2) | 3645 (37.3) |
| Not identified or unknown | 1917 (11.4) | 4285 (25.4) | 715 (10.1) | 1202 (12.3) |
| CCI score, mean (SD) | 1.2 (2.0) | 0.7 (1.5) | 1.5 (2.2) | 1.0 (1.8) |
| CCI, *n* (%) | | | | |
| 0 | 9207 (54.5) | 11629 (68.9) | 3268 (46.0) | 5939 (60.7) |
| 1 | 3326 (19.7) | 2554 (15.1) | 1587 (22.3) | 1739 (17.8) |
| ≥ 2 | 4355 (25.8) | 2705 (16.0) | 2248 (31.6) | 2107 (21.5) |

*CCI* Charleson Comorbidity Index, *NP* nurse practitioner, *PA* physician assistant, *PCP* primary care physician, *PN* prurigo nodularis

[a]Therapy received during the calendar year of inclusion

[b]Medicare data in the IQVIA PharMetrics® Plus database includes only claims data with active Medicare Advantage programs

[c]Other insurance includes self-insured

[d]Defined as the provider with the largest number of office visits during the study period

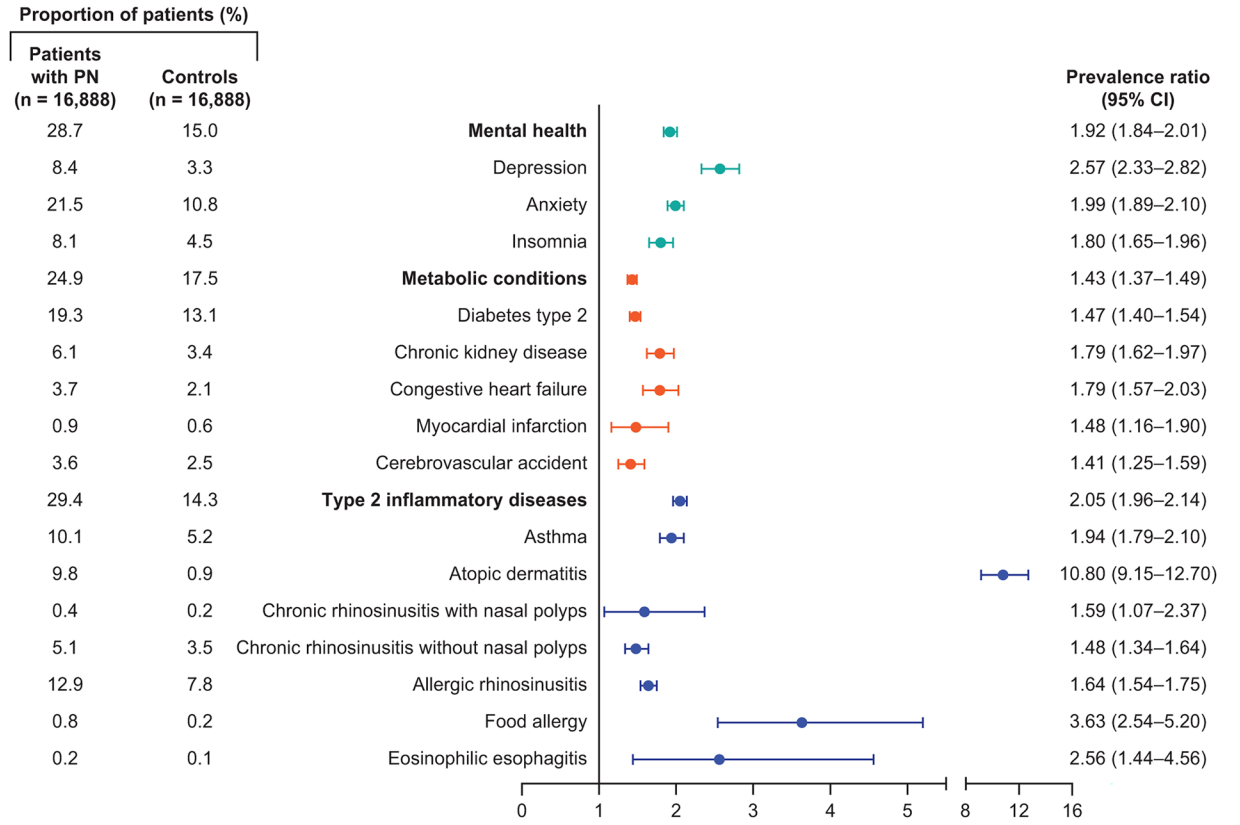


**Fig. 1** Frequency and prevalence ratio for each comorbidity in patients with PN versus matched controls. *PN* prurigo nodularis

conditions were significantly more common in the PN cohort than in the control cohort; the prevalence ratios for each comorbidity are summarized in Fig. 1. Of the comorbidities assessed, those with the highest prevalence ratios (95% CIs) in patients with PN versus controls were AD (10.80; 9.15–12.70), food allergy (3.63; 2.54–5.20), and eosinophilic esophagitis (2.56; 1.44–4.56).

## HCRU and Costs

All-cause annual HCRU is summarized in Table 2. The frequency of outpatient visits was highest, followed by emergency department visits and then hospitalizations. Mean (SD) number of outpatient physician (17.0 [15.5] vs 8.1 [10.7]; $P<0.001$) and dermatologist visits (2.7 [4.9] vs 0.3 [1.0]; $P<0.001$) was significantly greater in patients with PN compared with matched controls. A significantly greater proportion of patients with PN had emergency department visits compared with matched controls (22.5% vs 15.4%; $P<0.001$), and mean (SD) number of emergency department visits was also significantly greater in patients with PN (0.46 [1.63] vs 0.25 [0.79]; $P<0.001$). A significantly greater proportion of patients with PN had any inpatient hospitalization compared with matched controls (9.3% vs 5.9%; $P<0.001$), and mean (SD) number of inpatient hospitalizations was also significantly greater in patients with PN (0.17 [2.74] vs 0.08 [0.40]; $P<0.001$). Among patients with an inpatient hospitalization, mean (SD) length of stay was significantly longer for patients with PN than matched controls (10.6 [33.2] vs 6.7 [12.9] days; $P<0.001$).

Mean (SD) total healthcare costs were significantly greater for patients with PN than matched controls ($18,315 [$66,476] vs $8451 [$30,982]; $P<0.001$) (Fig. 2a), and patients with

**Table 2** All-cause annual healthcare resource for patients with PN and matched controls and subgroups of patients with PN receiving advanced versus localized/no therapy

| | Patients with PN (*n* = 16,888) | Controls (*n* = 16,888) | Patients with PN receiving advanced therapy[a] (*n* = 7103) | Patients with PN receiving localized/no therapy[a] (*n* = 9785) |
|---|---|---|---|---|
| Outpatient physician office visits | | | | |
| Outpatient physician office visits, mean (SD) | 17.0* (15.5) | 8.1 (10.7) | 21.7† (17.7) | 13.5 (12.6) |
| Dermatologist office visits, mean (SD) | 2.7* (4.9) | 0.3 (1.0) | 3.1† (6.4) | 2.0 (2.3) |
| Emergency department visits | | | | |
| Patients with any emergency department visit, *n* (%) | 3798 (22.5)* | 2601 (15.4) | 2018 (28.4)† | 1780 (18.2) |
| Emergency department visits, mean (SD) | 0.46* (1.63) | 0.25 (0.79) | 0.66†,b (2.19) | 0.31 (1.03) |
| Hospitalizations | | | | |
| Patients with any hospitalizations, *n* (%) | 1568 (9.3)* | 990 (5.9) | 906 (12.8)* | 662 (6.8) |
| Hospitalizations, mean (SD) | 0.17*,a (2.74) | 0.08 (0.40) | 0.27†,b (4.19) | 0.10 (0.48) |
| Length of stay among inpatients[c] (days), mean (SD) | 10.6* (33.2) | 6.7 (12.9) | 11.0 (36.5) | 10.1 (28.2) |

*PN* prurigo nodularis

*$P < 0.001$ vs controls

†$P < 0.001$ vs localized/no therapy

[a]Therapy received during the calendar year of inclusion

[b]Negative binomial test was used to compare patients with PN versus controls and patients with PN receiving advanced versus localized/no therapy during the year of inclusion

[c]Includes only patients with hospitalization

PN had significantly greater mean (SD) pharmacy ($4438 [$14,604] vs $1782 [$7912]; $P<0.001$) and medical claims costs (all nonpharmacy costs) ($13,876 [$62,273] vs $6669 [$29,049]; $P<0.001$). Medical claims costs for patients with PN were predominantly driven by nonprescription outpatient services, which were a mean (SD) of $9436 ($40,454) for the year. When adjusted for comorbidities with no clear mechanistic connection to PN that varied significantly between groups and for which high-cost treatments were likely, mean all-cause healthcare costs for patients with PN were $17,403 (95% CI $16,623–18,183) and for matched controls were $9363 (95% CI $8582–10,143) ($P<0.001$).

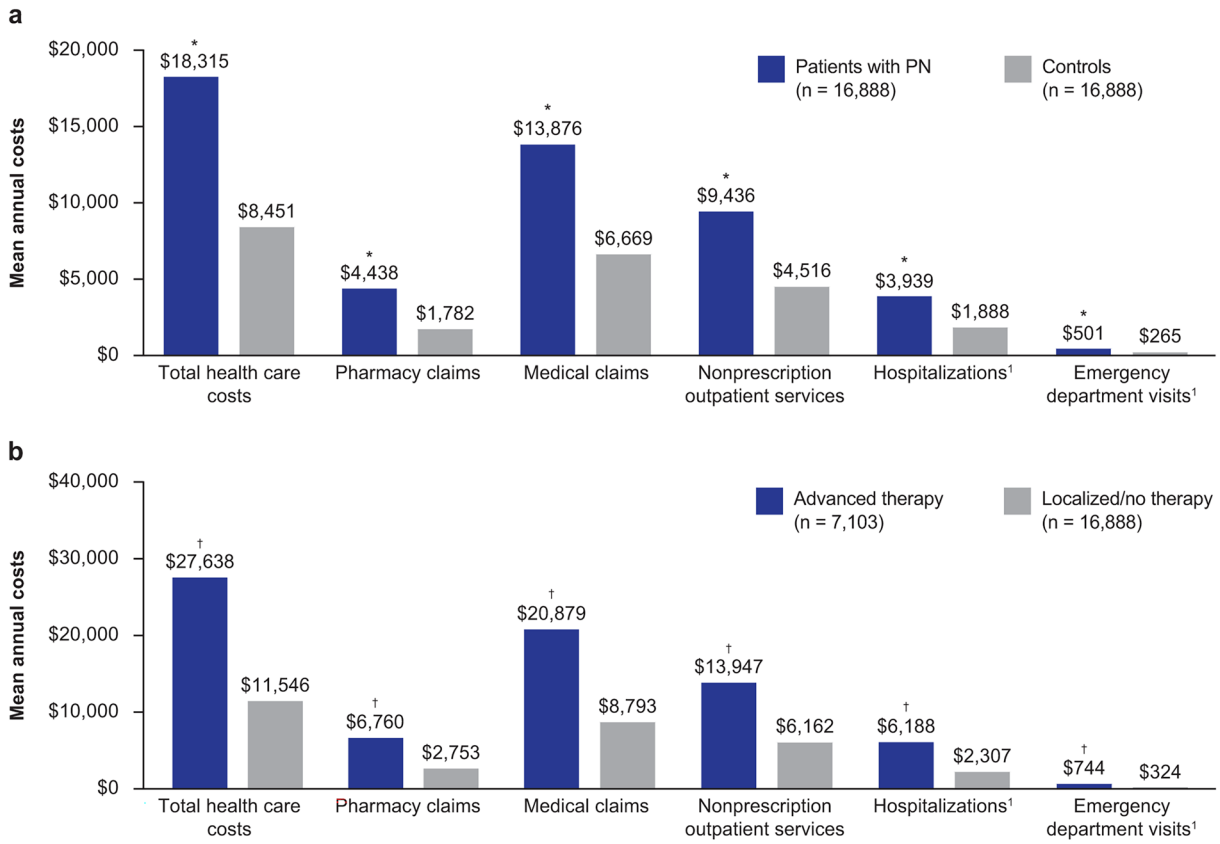


**Fig. 2** All-cause healthcare costs for **a** patients with PN and matched controls and **b** subgroups of patients with PN receiving advanced or localized/no therapy. Medical claims costs were the combined costs of nonprescription outpatient services, hospitalizations, and emergency department visits. *$P < 0.001$ versus controls. †$P < 0.001$ versus localized/no therapy. [1]A marginalized two-part model with logistic regression for zero versus nonzero costs and a gamma regression model for nonzero costs were used. *PN* prurigo nodularis

### Patients with PN Receiving Advanced Versus Localized/No Therapy

There were 7103 and 9785 patients with PN who were receiving advanced or localized/no therapy, respectively. The patient demographics and characteristics of the advanced and localized/no therapy subgroups of the PN cohort are summarized in Table 1; 59.2% of those who received advanced therapy and 51.6% of those who received localized/no therapy were female. Mean age of patients was 54.9 and 54.2 years for the advanced and localized/no therapy cohorts, respectively. Mean (SD) CCI score was 1.5 (2.3) in patients who received advanced therapy and 0.9 (1.7) in patients who received localized/no therapy. Compared with those who received localized/no therapy, patients with PN receiving advanced therapy had a significantly higher frequency of multiple comorbid conditions, including any advanced type 2 inflammatory comorbidities, allergic rhinitis, asthma, AD, food allergy, chronic rhinosinusitis without nasal polyps, chronic rhinosinusitis with nasal polyps, any mental health comorbidities, anxiety, depression, and insomnia (all $P < 0.001$) (Fig. 3). The prevalence ratios for each comorbidity are summarized in Fig. 3.

Patients who received advanced therapy had a higher mean (SD) number of physician office visits (21.7 [17.7] vs 13.5 [12.6]; $P < 0.001$) and dermatologist office visits (3.1 [6.4] vs

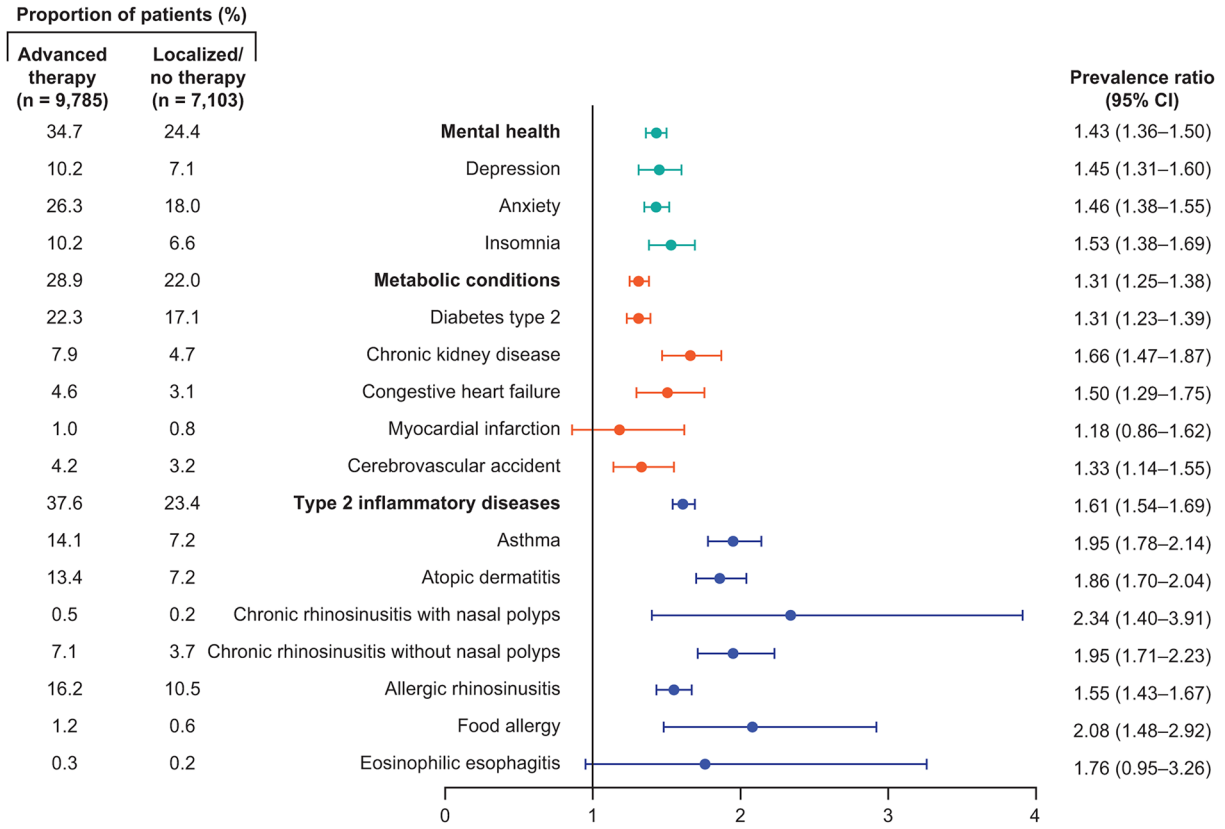


**Fig. 3** Prevalence ratio for each comorbidity in patients with PN receiving advanced versus localized/no therapy. *PN* prurigo nodularis

2.0 [2.3]; $P<0.001$), compared with patients who received localized/no therapy (Table 2). Patients who received advanced therapy also had a higher proportion of emergency department visits (28.4% vs 18.2%; $P<0.001$) and inpatient hospitalizations (12.8% vs 6.8%; $P<0.001$) than those who received localized/no therapy (Table 2). Patients with PN who received advanced therapy had higher mean (SD) total costs compared with those who received localized/no therapy ($27,638 [$93,667] vs $11,546 [$33,908]; $P<0.001$) (Fig. 2b); patients who received advanced therapy incurred significantly higher costs associated with pharmacy claims, emergency department visits, inpatient hospitalizations, and nonprescription outpatient services (all $P<0.001$) (Fig. 3). When adjusted by age group, sex, and selected comorbidities (i.e., those that were not clearly related to PN, varied significantly between groups, and were likely to be associated with high treatment costs: malignancy, Crohn's disease, ulcerative colitis, HIV, psoriasis), mean all-cause healthcare costs for patients with PN who received advanced therapy were $27,168 (95% CI $25,642–28,694) and for patients with PN who received localized/no therapy were $11,888 (95% CI $10,589–13,186).

## DISCUSSION

This study assessed the real-world healthcare burden of PN and associated costs in the USA using data from a large health plan claims database. Annual HCRU and associated costs were significantly higher for patients with PN than for matched controls. On average, patients with PN had experienced more outpatient visits and over double the number of inpatient

hospitalizations than matched controls for the year, and inpatient hospital stays were longer for those with PN. Mean healthcare costs for the year were substantially higher for patients with PN than for matched controls, even after adjusting for key morbidities. Medical claims costs were twice as high for patients with PN compared with matched controls. In a secondary analysis, patients with PN who received advanced therapy, and therefore who had more severe disease, incurred higher HCRU burden and associated costs than patients with PN who received localized/no therapy.

Our study is consistent with previous reports of comorbidities associated with PN. In a 2020 real-world claims-based study, the frequency of anxiety, chronic kidney disease, asthma, and AD in patients with PN was 21.3%, 3.6%, 8.4%, and 3.3%, respectively [4]. These results broadly align with the current study for anxiety (21.5%), chronic kidney disease (6.1%), and asthma (10.1%); however, the prevalence of AD was found to be almost three times higher in our study (9.8%). The difference in the prevalence of AD between the two studies may be due to methodological differences; the 2020 study included patient data from 2015 to 2016, with the approval of biologic treatment for AD (dupilumab) in 2017 [7], it is likely the clinical landscape changed during the subsequent years covered by our study (2016–2019). The frequency of comorbid diabetes mellitus was 19.3% for patients with PN in our study, with previously reported frequencies ranging from 8.8% to 15.9% [3, 4]. Similarly, for comorbid chronic heart failure and myocardial infarction, the respective frequencies in our study were 3.7% and 0.9%, broadly similar to previous studies reporting 1.5% to 11.0% and 0.6% to 3.0% [3, 4].

In our study, patients with PN had an average of 2.7 dermatology outpatient visits for the year; in a previous study of private insurance claims data, 1.4 visits per patient per year were reported [3]. Patients with PN in our study had nine times more dermatologist office visits than controls. However, a previous report found that patients with PN were more than 30 times as likely to be seen by a dermatologist compared with controls [11]. The discrepancy in magnitude between these two reports may be due to methodological differences; the previous study compared incidence rate ratios, and our study compared mean number of dermatologist office visits. The same previous study estimated a mean total healthcare spending of $8334 per patient over 15 months for patients with PN, which is less than half of what was identified in our study over a shorter time period (1 year) [11]. This discrepancy may be due to the exclusion of patients aged > 64 years in the previous study, who tend to have higher healthcare costs. Economic inflation during the time between the studies (2016 for the previous study and adjusted to 2019 for the current study) might also contribute to the difference in mean total healthcare spending. Also, it is unclear whether the previous study required continuous enrollment during the study period, as HCRU and costs for those who discontinued during the study period would be under-recorded and not be comparable to cost estimates from this study which are calculated from patients with continuous enrollment in the calendar year [11]. Similar to our findings, the majority of the total healthcare costs in the previous study were due to outpatient services [11]. When considering inpatient hospitalization, a cross-sectional study of the 2016 National Inpatient Sample found that patients with PN accounted for 3.7 inpatient visits per 100,000 discharges in the USA [12]. Patients with PN had a longer length of hospital stay (6.5 days vs 4.6 days; $P < 0.001$) and higher costs of care ($14,772 vs $11,728; $P < 0.001$) compared with patients without PN [12]. These observations were also supported by a real-world study of infectious disease hospitalizations [14]. The findings of these studies broadly align with the current study in that patients with PN have higher HCRU and costs compared with controls.

AD is a chronic inflammatory skin disease that is more common than PN, with an estimated prevalence of 6% to 13% in the USA [15]. A similar study of HCRU and costs for adults with AD in the USA identified mean annual healthcare costs of $11,660, approximately $4000 more than for matched controls [16]. To compare with our study, mean annual costs for patients with PN were approximately 50% higher and estimated to be approximately $10,000 more than for matched

controls. For those with more severe AD, mean annual costs were comparable with patients with PN ($15,000 vs $18,000); however, patients with more severe PN (advanced therapy cohort) had mean annual costs of $28,000, which is almost double that of patients with more severe AD. Although HCRU was broadly similar between the two diseases, PN appears to incur greater economic burden.

## STRENGTHS AND LIMITATIONS

This was a retrospective cross-sectional study based on data from a large US health plan claims database. The study included a large population, was conducted over several years, and included an analysis of patients with PN by treatment type (as a proxy for disease severity). It is important to consider that the use of treatment type (advanced vs localized/no therapy) as a proxy for disease severity might not be accurate in all cases and could subjectively inflate costs. Detailed data on other clinical variables, such as clinical diagnosis of disease, disease severity, and clinical symptoms status, were not available and might have provided further insight into disease severity and HCRU/costs. Nevertheless, claims data can only capture the dispensing of medication and cannot confirm whether the patient is taking the medication as prescribed. It is also important to consider that, being this was a cross-sectional study, patients with earlier versus later disease and patients who are responding to treatment versus those who are not cannot be differentiated and are all included in the analyses. Patients aged ≥ 65 years and those with two or more health plans are more likely to have claims missing in the IQVIA PharMetrics® Plus database and so data relating to these patients might not be complete [17]. Finally, this study is limited to only those individuals with commercial health insurance; therefore, findings in this study may not be generalizable to patients who are uninsured or covered by other insurance.

## CONCLUSIONS

This study confirmed that patients with PN have higher HCRU and costs than the general population, which is primarily driven by outpatient services. Patients with PN receiving advanced therapies have the highest HCRU and costs, which are also mostly due to outpatient services, suggesting that the burden of PN may rise with increasing disease severity.

## ACKNOWLEDGEMENTS

***Medical Writing/Editorial Assistance.*** Medical writing assistance was provided by Alice Newman, PhD, of Envision Value & Access and was funded by Regeneron Pharmaceuticals Inc, and Sanofi.

***Author Contributions.*** Shawn G. Kwatra: conceptualization, methodology, writing – original draft preparation, and writing – review & editing. Ashis K. Das: formal analysis, investigation, resources, writing – original draft preparation, and writing – review & editing. Eunice Chang: formal analysis, investigation, resources, writing – original draft preparation, and writing – review & editing. Caleb Paydar: formal analysis, investigation, writing – original draft preparation, and writing – review & editing. Donia Bahloul: conceptualization, formal analysis, investigation, writing – original draft preparation, and writing – review & editing. Chao Chen: conceptualization, formal analysis, investigation, writing – original draft preparation, and writing – review & editing. Ryan B. Thomas: conceptualization, formal analysis, investigation, methodology, project administration, resources, writing – original draft preparation, and writing – review & editing.

***Funding.*** This study, and Open Access publication fees, were funded by Regeneron Pharmaceuticals Inc and Sanofi.

***Data Availability.*** The datasets generated during and/or analyzed during the current

study are not publicly available as they were licensed for research use by the sponsor and are no longer available due to the end of the licensing agreement.

### *Declarations*

***Conflict of Interest.*** Shawn G. Kwatra is an advisory board member/consultant for AbbVie, Aslan Pharmaceuticals, Arcutis Biotherapeutics, Castle Biosciences, Celldex Therapeutics, Galderma, Genzada Pharmaceuticals, Incyte Corporation, Johnson & Johnson, Leo Pharma, Novartis Pharmaceuticals Corporation, Pfizer, Regeneron Pharmaceuticals Inc, and Sanofi and has served as an investigator for Galderma, Incyte, Pfizer, and Sanofi. Ashis K. Das, Eunice Chang, and Caleb Paydar are employees of PHAR. Donia Bahloul is an employee and stockholder of Sanofi. Chao Chen and Ryan B. Thomas are employees and stockholders of Regeneron Pharmaceuticals Inc.

***Ethical Approval.*** All data in IQVIA PharMetrics® Plus datasets are HIPPA (1996) compliant and deidentified to adhere with all relevant US regulations and privacy laws. As such, this study only analyzed deidentified data, which are a priori exempt from Institutional Review Board approval according to the Federal Policy for the Protection of Human Subjects "Common Rule" (1991, revised 2018).



## REFERENCES

1. Huang AH, Williams KA, Kwatra SG. Prurigo nodularis: epidemiology and clinical features. J Am Acad Dermatol. 2020;83(6):1559–65.
2. Williams KA, Roh YS, Brown I, et al. Pathophysiology, diagnosis, and pharmacological treatment of prurigo nodularis. Expert Rev Clin Pharmacol. 2021;14(1):67–77.
3. Wongvibulsin S, Sutaria N, Williams KA, et al. A nationwide study of prurigo nodularis: disease burden and healthcare utilization in the United States. J Invest Dermatol. 2021;141(10):2530-33.e1.
4. Huang AH, Canner JK, Khanna R, Kang S, Kwatra SG. Real-world prevalence of prurigo nodularis and burden of associated diseases. J Invest Dermatol. 2020;140(2):480-83.e4.
5. Sutaria N, Adawi W, Brown I, et al. Racial disparities in mortality among patients with prurigo nodularis: a multi-center cohort study. J Am Acad Dermatol. 2022;86(2):487–90.
6. Weigelt N, Metze D, Ständer S. Prurigo nodularis: systematic analysis of 58 histological criteria in 136 patients. J Cutan Pathol. 2010;37(5):578–86.
7. DUPIXENT. Prescribing information. Regeneron Pharmaceuticals Inc; 2024. https://www.regeneron.com/downloads/dupixent_fpi.pdf. Accessed 24 Apr 2024.
8. Elmariah S, Kim B, Berger T, et al. Practical approaches for diagnosis and management of prurigo nodularis: United States expert panel consensus. J Am Acad Dermatol. 2021;84(3):747–60.
9. NEMLUVIO. Prescribing information. Galderma Laboratories; 2024. https://www.galderma.com/sites/default/files/2024-08/Nemluviouspippi0812.pdf. 2024. Accessed 3 Sep 2024.
10. Whang KA, Mahadevan V, Bakhshi PR, et al. Prevalence of prurigo nodularis in the United States. J Allergy Clin Immunol Pract. 2020;8(9):3240–1.
11. Huang AH, Canner JK, Williams KA, Grossberg AL, Kwatra MM, Kwatra SG. Healthcare resource utilization and payer cost analysis of patients with prurigo nodularis. Br J Dermatol. 2020;183(1):182–4.

12. Whang KA, Kang S, Kwatra SG. Inpatient burden of prurigo nodularis in the United States. Medicines (Basel). 2019;6(3):88.

13. Whang KA, Le TK, Khanna R, et al. Health-related quality of life and economic burden of prurigo nodularis. J Am Acad Dermatol. 2022;86(3):573–80.

14. Sutaria N, Choi J, Roh YS, et al. Association of prurigo nodularis and infectious disease hospitalizations: a national cross-sectional study. Clin Exp Dermatol. 2021;46(7):1236–42.

15. Silverberg JI. Public health burden and epidemiology of atopic dermatitis. Dermatol Clin. 2017;35(3):283–9.

16. Drucker AM, Qureshi AA, Amand C, et al. Health care resource utilization and costs among adults with atopic dermatitis in the United States: a claims-based analysis. J Allergy Clin Immunol Pract. 2018;6(4):1342–8.

17. Cepeda MS, Fife D, Denarié M, Bradford D, Roy S, Yuan Y. Quantification of missing prescriptions in commercial claims databases: results of a cohort study. Pharmacoepidemiol Drug Saf. 2017;26(4):386–92.