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ORIGINAL RESEARCH

Treatment Patterns and Healthcare Resource Utilization Among Newly Diagnosed Psoriasis, Psoriatic Arthritis, Axial Spondyloarthritis, and Hidradenitis Suppurativa Patients with Past Diagnosis of an Inflammatory Condition: A Retrospective Cohort Analysis of Claims Data in the United States

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ABSTRACT

Introduction: Psoriasis (PSO), psoriatic arthritis (PsA), axial spondyloarthritis (axSpA), and hidradenitis suppurativa (HS) are chronic inflammatory diseases (CIDs) often diagnosed and treated individually. However, genetic overlaps exist among CIDs, and patients with one are at risk of developing others within the same spectrum. This analysis characterized treatment patterns along with clinical and economic burdens of newly diagnosed CIDs among patients with an additional past diagnosis of PSO, PsA, axSpA, or HS.

Methods: This study used MarketScan® databases to examine demographics, treatment patterns, and healthcare resource utilization for patients with ≥ 1 claim for PSO or HS or ≥ 2 claims for PsA or axSpA, and continuous enrollment in the year before (baseline period) and following (follow-up period) the date of first diagnosis (incident diagnosis). Comorbidities and new CID diagnoses with a past diagnosis of PSO, PsA, axSpA, or HS, were examined.

Results: The analysis included 298,794 patients (maximum of 1202 patients with ≥ 1 incident diagnoses): 134,233 had incident PSO; 9914 had incident PsA; 115,194 had incident axSpA; and 40,655 had incident HS. Prevalence of ≥ 1 CID diagnosis among patients with past diagnosis of PSO, PsA, axSpA, or HS was 4959/134,233 (3.7%), 5256/9914 (53.0%), 3205/115,194 (2.8%), and 1180/40,655 (2.9%), respectively. In patients with incident axSpA and past PsA diagnosis, incident axSpA and past HS diagnosis, and incident HS and past PSO diagnosis, steroid and opioid use were high across baseline and follow-up periods and use of biologic disease-modifying antirheumatic drugs increased from baseline to follow-up. Disease-related costs increased absolutely and increased or remained high as a proportion of all-cause costs.

Conclusion: Patients with newly diagnosed CIDs and additional past diagnosis of PSO, PsA, axSpA, or HS experienced high treatment utilization and healthcare costs. These findings

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highlight the need for payers, health technology assessment agencies, clinicians, and other stakeholders to explore the co-management of CIDs, rather than treating them separately.

Keywords: Axial spondyloarthritis; Hidradenitis suppurativa; Psoriasis; Psoriatic arthritis

Key Summary Points

Why carry out this study?

Psoriasis (PSO), psoriatic arthritis (PsA), axial spondyloarthritis (axSpA; comprising ankylosing spondylitis [AS], also known as radiographic axial spondyloarthritis [r-axSpA], and non-radiographic axial spondyloarthritis [nr-axSpA]), and hidradenitis suppurativa (HS) are chronic inflammatory diseases (CIDs) that are often treated as disparate individual diseases by payer and health technology assessment agencies.

However, there are substantial genetic overlaps among these diseases, and patients with one inflammatory condition are at a greater risk of developing others within a common disease spectrum.

Published literature characterizing the clinical and economic burden of patients with a newly diagnosed CID and additional past diagnosis of PSO, PsA, axSpA, or HS is limited.

What was learned from the study?

Results demonstrated that patients with a newly diagnosed CID and additional past diagnosis of PSO, PsA, axSpA, or HS experience increased proportions of treatment utilization in the year following diagnosis with a new CID compared with the year prior to their diagnosis, with inflammatory disease-related costs being the primary driver of high overall healthcare costs.

These findings highlight the need for payers, health technology assessment agencies, clinicians, and other stakeholders to explore the co-management of CIDs, as opposed to treating them as separate entities.

INTRODUCTION

Psoriasis (PSO), psoriatic arthritis (PsA), axial spondyloarthritis (axSpA), and hidradenitis suppurativa (HS) are chronic inflammatory diseases (CIDs) that cause considerable pain and disability. Each has its own presentation, treatment patterns, and burden of disease.

PSO

PSO is a chronic, inflammatory skin disease affecting over seven million adults in the USA and 55 million adults worldwide [1, 2]. Patients with PSO commonly present with raised, red patches of skin and typically experience skin pain, itching, and scaling. While dermatologic presentation of PSO is variable, the most prevalent form is plaque PSO [3]. Mild to moderate PSO may be treated with topical steroids, vitamin D analogues, and phototherapy. Moderate to severe disease often requires systemic treatment that may include small molecule therapies such as methotrexate, as well as biologic disease-modifying antirheumatic drugs (DMARDs), including tumor necrosis factor inhibitors (TNFis) and interleukin (IL)-17A inhibitors [3, 4]. The annual cost of PSO in the USA was estimated at approximately $112 billion in 2013. Annual medication costs are approximately $22,000 for patients receiving systemic biologic therapies [5, 6]. Nearly one-third of patients with PSO eventually progress to having PsA [7].

PsA

PsA is a chronic inflammatory musculoskeletal disease associated with inflammation of peripheral or axial joints, entheses, as well as

dactylitis in and dystrophy of nails in addition to skin involvement [8, 9]. PsA has an estimated prevalence of 1–2 per 1000 individuals in the US general population [10, 11]. Treatments for PsA vary depending on the affected biological structure and include symptomatic treatments such as non-steroidal anti-inflammatory drugs (NSAIDs) and glucocorticoids, in addition to immunomodulatory therapies, such as conventional synthetic targeted DMARDs as well as TNFi and IL-17A inhibitor biologics [8, 12]. The annual per person cost has been estimated to range from $11,000 to $17,000. Higher disease severity is associated with higher costs for patients with PsA [13].

axSpA

axSpA is a chronic inflammatory rheumatic disease primarily affecting the spine, with two main presentations: ankylosing spondylitis (AS), also known as radiographic axial spondyloarthritis (r-axSpA), and non-radiographic axial spondyloarthritis (nr-axSpA). Compared to AS, nr-axSpA is characterized by minimal or no damage to sacroiliac joints on pelvic radiography, although substantial subchondral bone inflammation is often detected on magnetic resonance imaging [14]. Estimates of the proportion of patients with nr-axSpA among patients with axSpA range widely, between 23% and 80%. It is estimated that approximately 10% of patients with nr-axSpA progress to AS within 2 years [15, 16].

The prevalence of axSpA within the USA is approximately 1% [16]. NSAIDs are typically recommended for initial treatment, but are often insufficient for managing the disease. Among approved biologic DMARDs, TNFis, and IL-17A inhibitors are commonly used. Targeted synthetic DMARDs, such as Janus kinase inhibitors (JAKis; tofacitinib and upadacitinib), are also used to treat AS in the USA [17, 18]. AS is associated with substantial healthcare costs, with estimates ranging from $6353 to $24,978 per person per year [19, 20]. nr-axSpA is also associated with high annual costs, ranging from €9374 to €20,328 per person, depending on the patient's country of residence [21].

HS

HS is a chronic, painful, and debilitating inflammatory skin disease that significantly and negatively impacts patients' quality of life [22]. The prevalence of HS varies globally and is approximately 0.05% to 4.1%, though true prevalence is difficult to define and may be greater given high levels of undiagnosed cases [23]. Current available treatments for HS focus on management of disease symptoms and include systemic antibiotics and other anti-inflammatory drugs. Adalimumab is the first biologic treatment approved for the treatment of HS in the USA, though other off-label biologic treatments have demonstrated effectiveness in disease management [24, 25]. Patients with HS are likely to incur high costs for disease management, with estimates of nearly $7000 more in direct healthcare costs over a 3-year period compared to patients without HS [26]. Furthermore, HS has been reported to be associated with low socioeconomic status, meaning its costs may represent a high burden [27].

Gaps in Literature and Objectives

Inflammatory conditions are often treated as distinct individual diseases by payer and health technology assessment agencies. However, there are substantial genetic overlaps among these diseases, and patients with one inflammatory condition can have greater risk of developing others within a common disease spectrum, experience disease exacerbation, or receive a new diagnosis after further observation or presentation of new symptoms [22, 28, 29]. Given there is often overlap in symptom presentation across inflammatory diseases and delayed diagnosis, there is a need for improved accuracy of diagnosis and interdisciplinary disease management from multiple specialists including dermatologists, rheumatologists, and gastroenterologists. Despite this, published literature characterizing the clinical and economic burdens of a newly diagnosed CID with additional past diagnosis of PSO, PsA, axSpA, or HS is limited.

This study aimed to characterize separately diagnosed CIDs among patients with PSO, PsA, axSpA, and HS, and describe the clinical and economic burden among these patients. The primary objective of the study was to describe demographics, comorbidities, treatment characteristics, healthcare resource utilization (HCRU), and costs in the year preceding diagnosis (baseline [BL] period) among patients with incident PSO, PsA, axSpA, and HS.

The secondary objective of the study was to describe demographics, comorbidities, treatment characteristics, HCRU, and costs in the BL period and in the year after diagnosis (follow-up [FU] period) among three subgroups of patients with incident diagnoses of interest and an additional past CID diagnosis (incident axSpA with past PsA diagnosis, incident axSpA with past HS diagnosis, and incident HS with past PSO diagnosis).

METHODS

Study Design

This was a retrospective cohort study of three US MarketScan® databases, the Commercial Claims and Encounters Database, the Medicare Supplemental and Coordination of Benefits Database, and the Medicaid Database, from December 31, 2007 to September 30, 2019. MarketScan® databases capture longitudinal, individual-level administrative claims data drawn from large employers, health plans, and public organizations in the USA. Information on plan enrollment, healthcare utilization and expenditures, demographics, and integrated records for inpatient events, outpatient events, and pharmacy dispensing were available for analysis.

The index date was set as the earliest date of the first qualifying diagnosis of PSO, PsA, axSpA, or HS. Patients were eligible for inclusion if the index date occurred within the patient identification period, spanning from January 1, 2015 to September 30, 2018. To identify patients with incident inflammatory conditions, a washout of the index diagnosis from all available data prior to the index date was required.

All available data prior to the index date were used to identify additional past CID diagnoses and comorbid conditions. Treatment characteristics, HCRU, and costs were evaluated in the BL period, defined as the 1-year period prior to the patient's index date. Patient demographics were assessed on the index date. Treatment characteristics, HCRU, and costs were assessed in the FU period, defined as the 1-year period following the patient's index date. The full study design is shown in Fig. 1.

MarketScan® is Health Insurance Portability and Accountability Act (HIPAA) compliant. As patient data were de-identified, the use of these data does not constitute human subject research and does not require approval from an institutional review board.

Population

Patients were eligible for inclusion if they had at least one qualifying incident diagnosis claim for PSO or HS, or at least two claims for PsA or axSpA (as symptoms for these conditions evolve over time which can result in a change of diagnosis) [30, 31] during the identification period; for patients with axSpA and PsA, the second diagnosis claim must have occurred at least 30 days and at most 364 days after the first claim. Patients with multiple qualifying index conditions were indexed on the basis of their first incident diagnosis chronologically. All patients were required to have continuous health plan enrollment for 1 year prior to and following the index date to assess HCRU, costs, and other characteristics of interest over a full year of BL and FU. Patients less than 18 years of age or with missing age at the index date were excluded. Additionally, patients were excluded if they had any prior claims corresponding to the index disease during the washout period.

Outcome Definition and Measurement

For the primary objective, demographic characteristics including age, gender, and insurance type were assessed on the index date. Additional

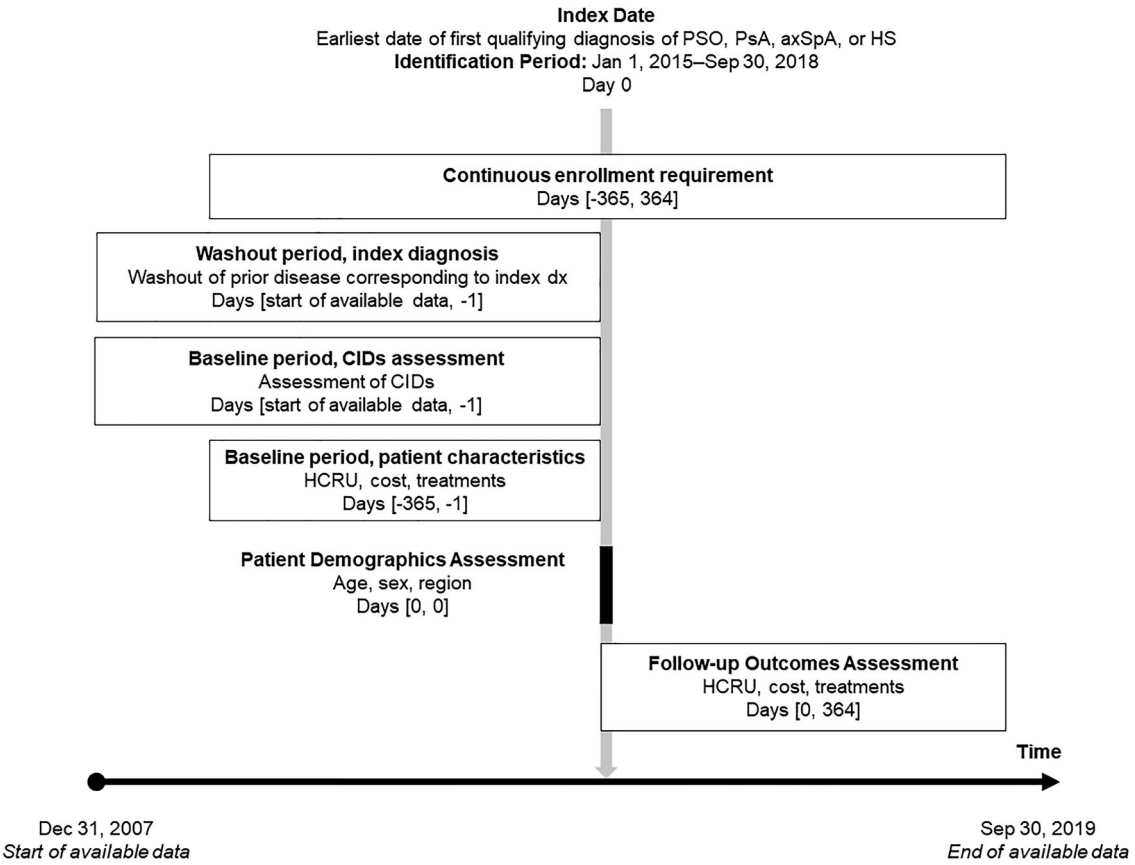


Fig. 1 Study design. *axSpA* axial spondyloarthritis, *CID* chronic inflammatory disease, *Dx* diagnosis, *HCRU* healthcare resource use, *HS* hidradenitis suppurativa, *PsA* psoriatic arthritis, *PSO* psoriasis

past CID diagnoses and comorbidities were assessed over all available data prior to the index date. The proportions of patients with additional past CID diagnoses and comorbidities, as identified with the corresponding International Classification of Diseases, ninth and tenth edition (ICD-9 and ICD-10) diagnostic codes (Supplementary Material Table S1), are reported. Deyo–Charlson Comorbidity Index was calculated for patients over a 365-day lookback from the index date.

For the secondary objective, treatment patterns, HCRU, and costs were assessed during the BL and FU periods. Treatment patterns are reported as the percentage of patients receiving any biologic DMARD, non-biologic DMARDs, NSAIDs, opioids, or any corticosteroid (therapies by treatment type are listed in Supplementary Material Table S2); the mean number of claims for each treatment type are also reported. Measures of HCRU included inpatient visits, outpatient visits, emergency room visits, and pharmacy claims. Each measure of HCRU is reported for all-cause visits (any claim) and inflammatory disease-related visits (any medical claim associated with an inflammatory disease code and any pharmacy claim for treatment of inflammatory disease). Costs during the 12-month BL and FU periods are reported as total amounts and separately by inpatient, outpatient (including emergency room visits), and pharmacy for both all-cause (costs associated with any claim) and inflammatory disease-related categories (costs associated with medical claims with an inflammatory disease code or pharmacy claims for treatment of inflammatory disease). Costs reported are inclusive of all plan-paid costs and out-of-pocket costs. Cost adjustments were made using the consumer price index (CPI) and reported in 2018 US dollars.

Table 1 Baseline demographics among patients with incident axSpA, HS, PsA, or PSO

	Overall (N = 298,794)	axSpA (n = 115,194)	HS (n = 40,655)	PsA (n = 9914)	PSO (n = 134,233)
Age (years)[a]					
Mean (SD)	48.08 (14.99)	50.73 (14.13)	37.74 (13.41)	50.55 (12.29)	48.75 (15.02)
Median [IQR]	49 [37, 58]	51 [41, 60]	36 [27, 48]	52 [43, 59]	50 [38, 59]
Gender (%)[a]					
Male	37.3%	34.4%	23.5%	40.6%	43.8%
Female	62.7%	65.6%	76.5%	59.4%	56.2%
Insurance type (%)[a]					
Commercial	75.6%	71.8%	68.6%	82.9%	80.6%
Medicaid	13.7%	15.2%	29.3%	7.8%	8.1%
Medicare	10.7%	13.0%	2.2%	9.4%	11.3%
Days of baseline enrollment available for assessment of prevalent conditions[b]					
Mean (SD)	1745 (1008)	1817 (1016)	1614 (987)	1755 (1018)	1720 (1001)
Median [IQR]	1599 [805, 2656]	1723 [859, 2743]	1332 [748, 2495]	1672 [769, 2650]	1583 [782, 2625]
Comorbid diseases (%)[b]					
RA	3.7%	4.2%	1.7%	17.6%	2.9%
UC	1.5%	1.8%	1.2%	1.6%	1.4%
CD	1.5%	1.6%	1.5%	1.6%	1.3%
SLE	1.2%	1.4%	1.0%	3.3%	0.9%
Anxiety	32.3%	39.2%	32.7%	32.0%	26.3%
Depression	28.2%	35.0%	30.6%	27.8%	21.7%
Hyperlipidemia	47.1%	53.1%	32.2%	52.2%	45.9%
Hypertension	44.0%	49.9%	35.5%	49.5%	41.1%
Deyo–Carlson Comorbidity Index[c]					
Mean (SD)	0.70 (1.28)	0.83 (1.38)	0.60 (1.18)	0.88 (1.29)	0.61 (1.22)
Median [IQR]	0.00 [0.00, 1.00]	0.00 [0.00, 1.00]	0.00 [0.00, 1.00]	0.00 [0.00, 1.00]	0.00 [0.00, 1.00]

axSpA axial spondyloarthritis, *CD* Crohn's disease, *HS* hidradenitis suppurativa, *IQR* interquartile range, *PsA* psoriatic arthritis, *PSO* psoriasis, *RA* rheumatoid arthritis, *SD* standard deviation, *SLE* systemic lupus erythematosus, *UC* ulcerative colitis

[a]Demographics were assessed on index date

[b]Assessed over all available data prior to index date

[c]Calculated for over a 365-day lookback from the index date

Table 2 Prior CID diagnoses among patients with incident PSO, PsA, axSpA, or HS

	axSpA (*n* = 115,194)	HS (*n* = 40,655)	PsA (*n* = 9914)	PSO (*n* = 134,233)
CIDs prior to incident diagnosis[a]				
0 CIDs, *n* (%)	111,989 (97.2)	39,475 (97.1)	4658 (47.0)	129,274 (96.3)
≥ 1 CID, *n* (%)				
Prior diagnosis of PSO	2475 (2.1)	771 (1.9)	4,919 (49.6)	–
Prior diagnosis of PsA	575 (0.5)	113 (0.3)	–	2831 (2.1)
Prior diagnosis of axSpA	–	406 (1.0)	425 (4.3)	1604 (1.2)
Prior diagnosis of HS	561 (0.5)	–	68 (0.7)	699 (0.5)
≥ 2 CIDs, *n* (%)				
Prior diagnoses of PSO, PsA	379 (0.3)	96 (0.2)	–	–
Prior diagnoses of PSO, axSpA	–	12 (< 0.1)	110 (1.1)	–
Prior diagnoses of PSO, HS	27 (< 0.1)	–	44 (0.4)	–
Prior diagnoses of PsA, axSpA	–	9 (< 0.1)	–	153 (0.1)
Prior diagnoses of PsA, HS	4 (< 0.1)	–	–	13 (< 0.1)
Prior diagnoses of axSpA, HS	–	–	5 (0.1)	13 (< 0.1)
≥ 3 CIDs, *n* (%)				
Prior diagnoses of PSO, PsA, axSpA	–	7 (< 0.1)	–	–
Prior diagnoses of PSO, PsA, HS	4 (< 0.1)	–	–	–
Prior diagnoses of PSO, axSpA, HS	–	–	3 (< 0.1)	–
Prior diagnoses of PsA, axSpA, HS	–	–	–	4 (< 0.1)

Groups are not mutually exclusive, patients with multiple index diagnoses on the same day will be reported among all qualifying groups
axSpA axial spondyloarthritis, *CID* chronic inflammatory disease, *HS* hidradenitis suppurativa, *PsA* psoriatic arthritis, *PSO* psoriasis
[a]Assessed over all available data prior to index date, exclusive

Statistical Analysis

Descriptive statistics were used to evaluate BL demographics, additional past CID diagnoses and comorbidities, as well as treatment patterns, HCRU, and costs. Continuous variables, such as age and costs, were reported as mean and standard deviation (SD), and median and interquartile range (IQR). Dichotomous outcomes, such as additional past CID diagnoses, comorbidities, and treatment patterns, were described as number and percentage (*n*, %). No imputations on missing data were performed.

RESULTS

Primary Objective: Prevalence of All Additional Past CID Diagnoses and Comorbidities

The analysis carried out for the primary objective included 298,794 patients: 134,233 (44.9%) with incident PSO, 9914 (3.3%) with incident PsA, 115,194 (38.6%) with incident axSpA, and 40,655 (13.6%) with incident HS. Incident cohorts were not mutually exclusive groups, and the small number of patients with multiple index diagnoses on the same day (a maximum of 1202, 0.4% of all patients) were reported among all qualifying groups in stratified analyses. BL patient characteristics, including age, gender, and insurance type are reported in Table 1.

Incident CIDs with Past CID Diagnoses and Comorbidities

The prevalence of at least one CID diagnosis in the BL period among patients with incident PSO was 3.7% (2.1%, 1.2%, or 0.5% for PSO with additional past diagnosis of PsA, axSpA, or HS, respectively); among patients with incident PsA it was 53.0% (49.6%, 4.3%, or 0.7% for PsA with additional past diagnosis of PSO, axSpA, or HS); among patients with incident axSpA it was 2.8% (2.1%, 0.5%, or 0.5% for axSpA with additional past diagnosis of PSO, PsA, or HS); and among patients with incident HS it was 2.9% (1.9%, 0.3%, or 1.0% for HS with additional past diagnosis of PSO, PsA, or axSpA).

The percentage of patients with at least two CID diagnoses in the BL period was generally lower than the percentage for at least one CID diagnosis. Of patients with incident PSO, 153 (0.1%) had additional past diagnoses of axSpA and PsA, while 13 (< 0.1%) had additional past diagnoses of HS and PsA, and 13 (< 0.1%) had additional past diagnoses of axSpA and HS. Only four (< 0.1%) patients with incident PSO had at least three additional past CID diagnoses (Table 2). Among patients with incident PsA, 110 (1.1%) had additional past diagnoses of axSpA and PSO, while 44 (0.4%) had additional past diagnoses of PSO and HS, and five (0.1%) had additional past diagnoses of axSpA and HS. Three (< 0.1%) patients with incident PsA had at least three additional past CID diagnoses. Of patients with incident axSpA, 379 (0.3%) had additional past diagnoses of PSO and PsA, 27 (< 0.1%) had additional past diagnoses of PSO and HS, four (< 0.1%) had additional past diagnoses of PSA and HS, and four (< 0.1%) had additional past diagnoses of PSO, PsA, and HS. Patients with incident HS had similarly low proportions of at least two and at least three additional past CID diagnoses: 96 (0.2%) with additional past diagnoses of PsA and PSO, 12 (< 0.1%) with additional past diagnoses of PSO and axSpA, nine with additional past diagnoses of PsA and axSpA, and seven (< 0.1%) with additional past diagnoses of PSO, PsA, and axSpA.

Among patients with incident inflammatory disease, common non-inflammatory comorbidities included hyperlipidemia and hypertension, ranging from 45.9% to 53.1% and 41.1% to 49.9%, respectively, in patients with incident PSO, PsA, and axSpA. Prevalence of hyperlipidemia and hypertension was lower for patients with HS, at 32.2% and 35.5%, respectively. Proportions of anxiety and depression ranged from 26.3% to 39.2% and 21.7% to 35.0% across disease cohorts, with the lowest proportions seen in patients with incident PSO and the highest proportions in patients with incident axSpA (Table 1).

Table 3 Baseline comorbidities and demographics among patients with most common additional past CID diagnoses

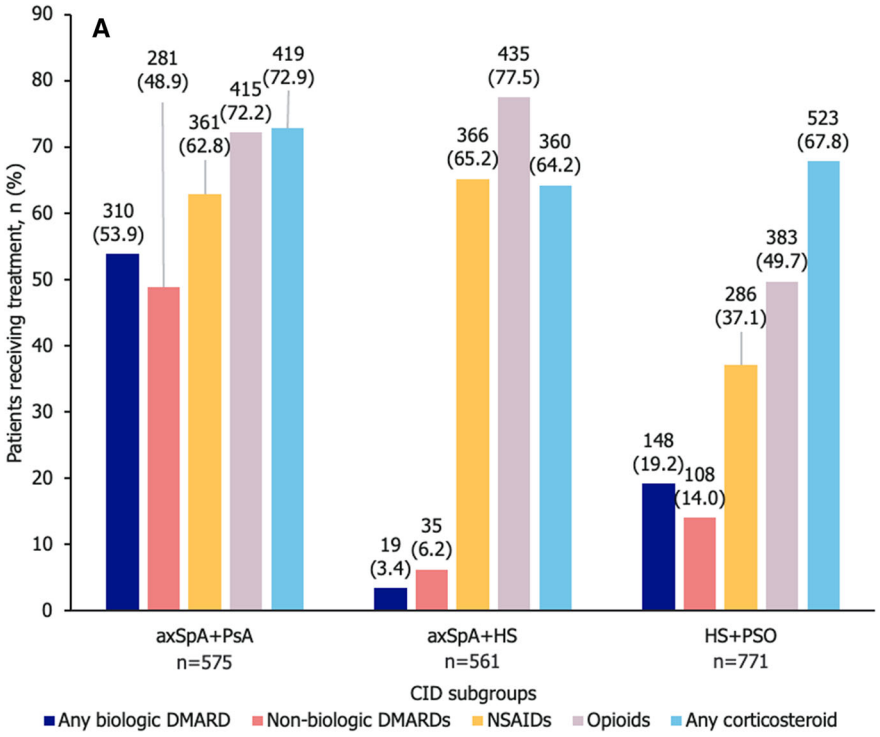
	axSpA + PsA (*n* = 575)	axSpA + HS (*n* = 561)	HS + PSO (*n* = 771)
Demographics[a]			
Age (years)			
Mean (SD)	53.61 (11.36)	45.56 (11.96)	43.32 (14.08)
Median [IQR]	54.00 [47.00, 61.00]	45.00 [37.00, 54.00]	43.00 [33.00, 55.00]
Gender, *n* (%)			
Male	211 (36.7%)	101 (18.0%)	211 (27.4%)
Female	364 (63.3%)	460 (82.0%)	560 (72.6%)
Insurance type, *n* (%)			
Commercial	446 (77.6%)	352 (62.7%)	595 (77.2%)
Medicaid	44 (7.7%)	178 (31.7%)	144 (18.7%)
Medicare	85 (14.8%)	31 (5.5%)	32 (4.2%)
Days of baseline enrollment available for assessment of prevalent conditions			
Mean (SD)	1835 (1032)	2075 (996)	1974 (1002)
Median [IQR]	1784 [792, 2789]	2185 [1142, 2876]	2018 [1023, 2815]
Comorbidities			
Past CID diagnosis in baseline[b]			
PSO	379 (65.9%)	27 (4.8%)	771 (100.0%)
PsA	575 (100.0%)	4 (0.7%)	96 (12.5%)
axSpA	0 (0.0%)	0 (0.0%)	12 (1.6%)
HS	4 (0.7%)	561 (100.0%)	0 (0.0%)
RA	183 (31.8%)	34 (6.1%)	41 (5.3%)
SLE	25 (4.3%)	16 (2.9%)	13 (1.7%)
CD	17 (3.0%)	21 (3.7%)	33 (4.3%)
UC	19 (3.3%)	21 (3.7%)	27 (3.5%)
Deyo–Charlson Comorbidity Index[c]			
Mean (SD)	1.24 (1.54)	1.15 (1.56)	0.80 (1.24)
Median [IQR]	1.00 [0.00, 2.00]	1.00 [0.00, 2.00]	0.00 [0.00, 1.00]

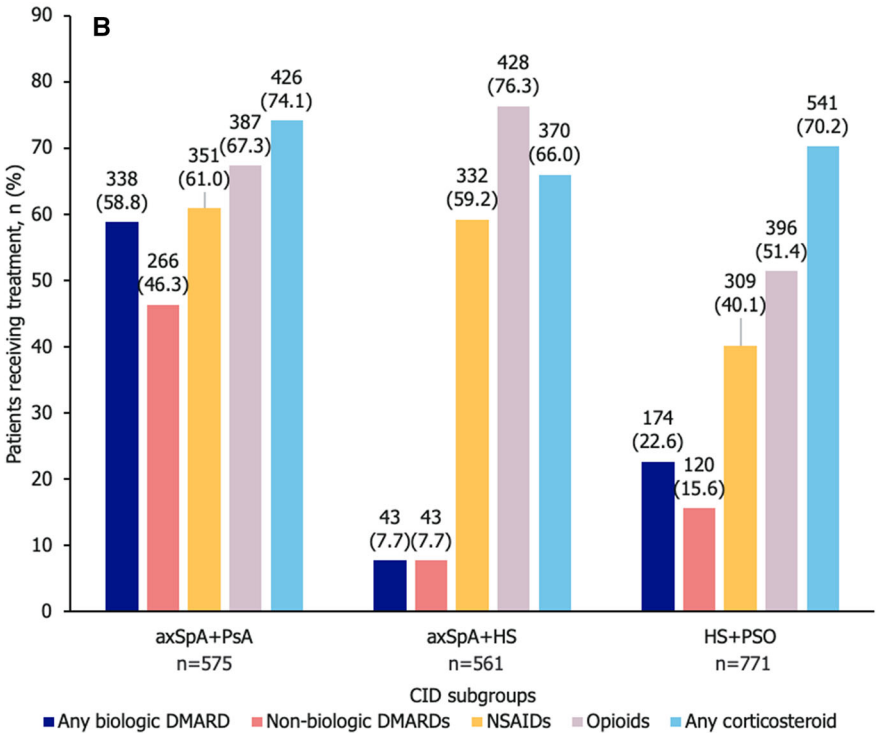
axSpA axial spondyloarthritis, *CD* Crohn's disease, *CID* chronic inflammatory disease, *HS* hidradenitis suppurativa, *IQR* interquartile range, *PsA* psoriatic arthritis, *PSO* psoriasis, *RA* rheumatoid arthritis, *SD* standard deviation, *SLE* systemic lupus erythematosus, *UC* ulcerative colitis

[a]Assessed on index date

[b]Assessed over all available data prior to index date

[c]Calculated for over a 365-day lookback from the index date


A
Patients receiving treatment, n (%)
90
80
70
60
50
40
30
20
10
0
310 (53.9)
281 (48.9)
361 (62.8)
415 (72.2)
419 (72.9)
19 (3.4)
35 (6.2)
366 (65.2)
435 (77.5)
360 (64.2)
148 (19.2)
108 (14.0)
286 (37.1)
383 (49.7)
523 (67.8)
axSpA+PsA n=575
axSpA+HS n=561
HS+PSO n=771
CID subgroups
Any biologic DMARD
Non-biologic DMARDs
NSAIDs
Opioids
Any corticosteroid


B
Patients receiving treatment, n (%)
90
80
70
60
50
40
30
20
10
0
338 (58.8)
266 (46.3)
351 (61.0)
387 (67.3)
426 (74.1)
43 (7.7)
43 (7.7)
332 (59.2)
428 (76.3)
370 (66.0)
174 (22.6)
120 (15.6)
309 (40.1)
396 (51.4)
541 (70.2)
axSpA+PsA n=575
axSpA+HS n=561
HS+PSO n=771
CID subgroups
Any biologic DMARD
Non-biologic DMARDs
NSAIDs
Opioids
Any corticosteroid

◀**Fig. 2** Treatment patterns among patients with selected past additional CID diagnoses in **A** baseline and **B** follow-up periods. *axSpA* axial spondyloarthritis, *CID* chronic inflammatory disease, *DMARD* disease-modifying anti-rheumatic drug, *HS* hidradenitis suppurativa, *NSAID* non-steroidal anti-inflammatory drug, *PsA* psoriatic arthritis, *PSO* psoriasis

Costs

Patients with incident PsA had the highest mean all-cause and inflammatory disease-related costs in the BL period: $21,831 and $8716, respectively. Patients with incident PSO, axSpA, and HS generally had lower mean all-cause costs ($11,883, $17,781, and $10,345, respectively) and inflammatory disease-related costs ($1316, $1029, and $551, respectively; Supplementary Material Table S3).

Secondary Objective: Burden of Disease Analysis of CIDs of Interest

Three subgroups were selected for analysis for the secondary objective: a cohort with incident axSpA and additional past diagnosis of PsA (axSpA + PsA) that included 575 patients, a cohort with incident axSpA and additional past diagnosis of HS (axSpA + HS) that included 561 patients, and a cohort with incident HS and additional past diagnosis of PSO (HS + PSO) that included 771 patients. Each subgroup had more female than male patients: 63.3% female for axSpA + PsA, 82.0% for axSpA + HS, and 72.6% for HS + PSO. The median age at index diagnosis was 54, 45, and 43 years across the three groups, respectively (Table 3).

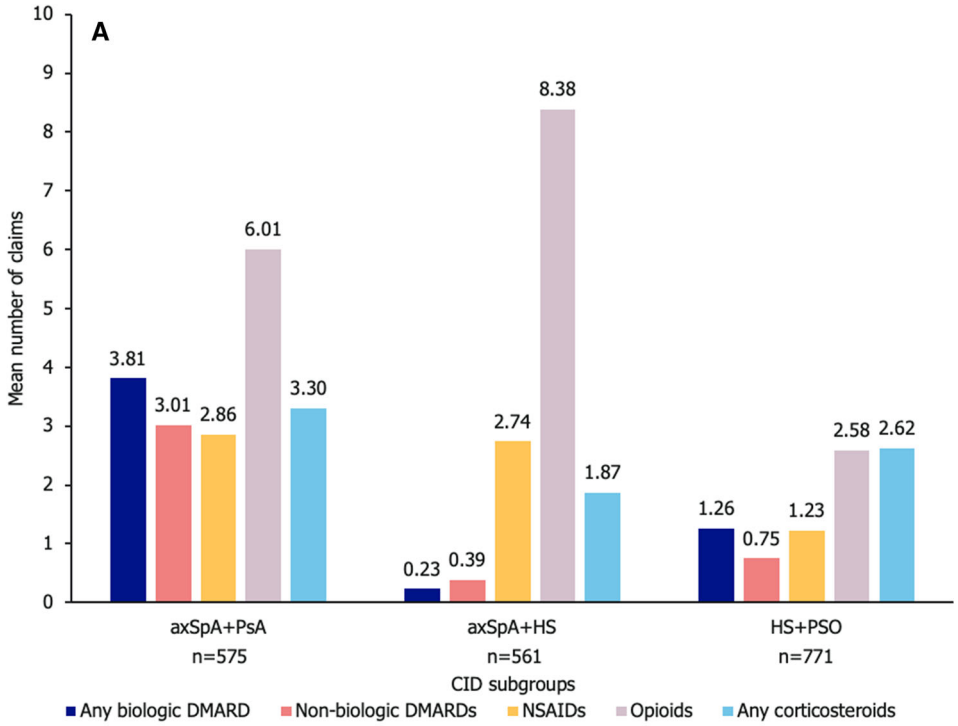
Treatment Patterns

Use of any corticosteroid, including oral corticosteroids, injectable/intravenous steroids, and topical steroids, was high across subgroups in the BL and FU periods (Fig. 2). The proportion of patients using corticosteroids was highest in patients with axSpA + PsA (BL 72.9%; FU 74.1%), followed by patients with HS + PSO (BL 67.8%; FU 70.2%), and patients with axSpA + HS (BL 64.2%; FU 66.0%). Steroids were predominately oral for axSpA + PsA (46.4% patients used oral corticosteroids in the BL period) and axSpA + HS (44.6% patients used oral corticosteroids in the BL period) and predominantly topical for HS + PSO (52.9% patients used topical steroids in the BL period).

Opioid use was similarly high, with the highest proportions in the axSpA + HS subgroup (BL 77.5%; FU 76.3%), followed by the axSpA + PsA subgroup (BL 72.2%; FU 67.3%), and the HS + PSO subgroup (BL 49.7%; FU 51.4%). Proportions of opioid use decreased from the BL period to the FU period in the axSpA + PsA (from 72.2% to 67.3%) and axSpA + HS (from 77.5% to 76.3%) subgroups but increased in the HS + PSO subgroup (from 49.7% to 51.4%). However, the mean number of claims per patient for opioids increased across all subgroups (Fig. 3).

Across subgroups, the mean number of claims for and percentages of patients using biologic DMARDs increased from the BL period to the FU period (Figs. 2, 3). For patients with axSpA + PsA, the percentage of patients using biologic DMARDs was 53.9% in the BL period and 58.8% in the FU period, and the mean number of claims per patient per year increased from 3.81 in the BL period to 4.26 in the FU period. Proportions of patients with biologic DMARD use were lower in the HS + PSO and axSpA + HS subgroups, increasing from 19.2% to 22.6% and 3.4% to 7.7% in the BL and FU periods, respectively. The mean number of claims per patient per year rose from 1.26 in the BL period to 1.49 in the FU period in the HS + PSO subgroup and from 0.23 to 0.58 in the axSpA + HS subgroup. The most common biologic DMARD class across subgroups was TNFi. In the BL period and FU period, 3.0–46.8% and 6.6–47.8% of patients had claims for TNFi use, respectively.

Proportions of patients with NSAID use were high across subgroups, decreasing from the BL period to the FU period in the axSpA + HS subgroup (BL 65.2%; FU 59.2%) and the axSpA + PsA subgroup (BL 62.8%; FU 61.0%), and increasing in the HS + PSO subgroup (BL 37.1%; FU 40.1%). The mean number of claims per patient per year for NSAIDs increased across all subgroups from the BL period to the FU period: axSpA + PsA (BL 2.86; FU 3.04);


A
Mean number of claims
10
9
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1
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3.81
3.01
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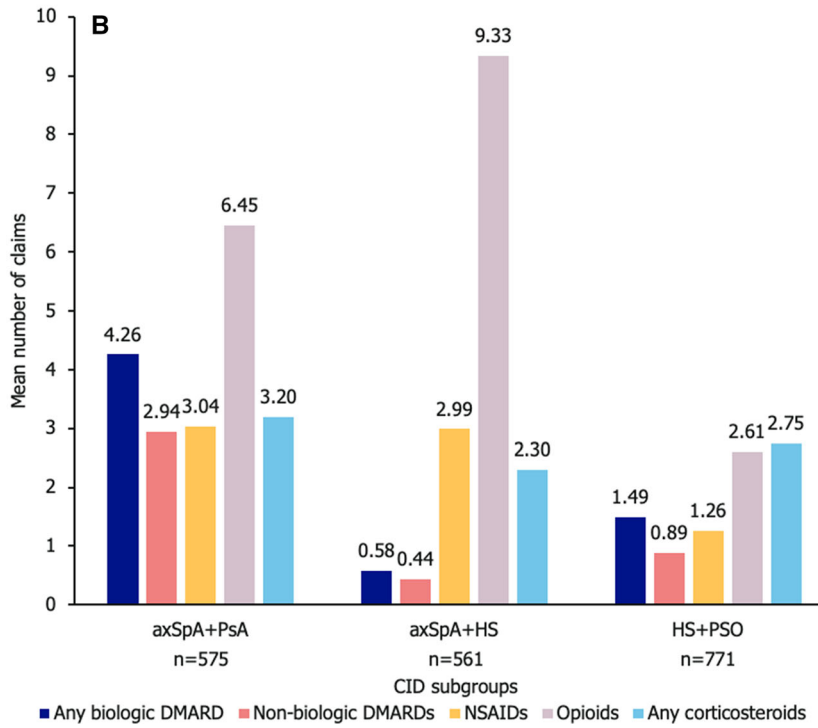
3.30
0.23
0.39
2.74
8.38
1.87
1.26
0.75
1.23
2.58
2.62
axSpA+PsA
n=575
axSpA+HS
n=561
HS+PSO
n=771
CID subgroups
Any biologic DMARD
Non-biologic DMARDs
NSAIDs
Opioids
Any corticosteroids


B
Mean number of claims
10
9
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4.26
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3.04
6.45
3.20
0.58
0.44
2.99
9.33
2.30
1.49
0.89
1.26
2.61
2.75
axSpA+PsA
n=575
axSpA+HS
n=561
HS+PSO
n=771
CID subgroups
Any biologic DMARD
Non-biologic DMARDs
NSAIDs
Opioids
Any corticosteroids

◀**Fig. 3** Claims for treatments among patients with selected past additional CID diagnoses in **A** baseline and **B** follow-up periods. *axSpA* axial spondyloarthritis, *DMARD* disease-modifying antirheumatic drug, *CID* chronic inflammatory disease, *HS* hidradenitis suppurativa, *NSAID* non-steroidal anti-inflammatory drug, *PsA* psoriatic arthritis, *PSO* psoriasis

axSpA + HS (BL 2.74; FU 2.99); HS + PSO (BL 1.23; FU 1.26).

HCRU

Percentages of all-cause and inflammatory disease-related HCRU among patients with a newly diagnosed CID and additional past diagnosis of PSO, PsA, axSpA, or HS are presented in Fig. 4. Among patients with at least one pharmacy claim, a majority of patients (> 85%) across subgroups had at least one inflammatory-related pharmacy encounter during both the BL and FU periods.

Costs

All-cause and inflammatory disease-related costs in the BL and FU periods are shown in Fig. 5. Inflammatory disease-related costs per person increased from BL to FU across all subgroups with the highest costs in patients with axSpA + PsA (BL $27,683; FU $34,169), followed by HS + PSO (BL $8274; FU $11,515) and axSpA + HS (BL $2397; FU $6029). The proportion of inflammatory disease-related costs as a subset of all-cause costs was highest in the BL and FU among patients with axSpA + PsA (BL 54.1%; FU 53.6%), followed by patients with HS + PSO (BL 34.0%; FU 38.4%) and axSpA + HS (BL 10.4%; FU 21.6%). The proportion of inflammatory disease-related costs by HCRU type is presented in Fig. 6. Inflammatory disease-related pharmacy costs as a proportion of all-cause treatment costs increased from BL to FU across all subgroups. The axSpA + PsA subgroup had the highest proportion of inflammatory disease-related pharmacy costs as a subset of all-cause pharmacy costs (BL 81.4%; FU 83.6%) followed by HS + PSO (BL 69.2%; FU 75.6%) and axSpA + HS (BL 31.0%; FU 46.4%).

DISCUSSION

This study identified patients with newly diagnosed PSO, PsA, axSpA, or HS and described the demographics, comorbidities, treatment characteristics, and costs for these patients.

Among patients with incident PSO, axSpA, and HS, the proportion who had a history of additional past CID diagnoses was small. However, around half of patients with incident PsA had a prior diagnosis of PSO. The high number of patients with incident PsA and past diagnosis of PSO is likely since many patients with PSO eventually progress to develop PsA [7]. In addition, physicians may diagnose PSO and PsA separately because of uncertainty or overlapping diagnostic criteria [32, 33].

All-cause costs during the year prior to incident disease diagnosis were highest for those with incident PsA followed by those with incident axSpA. Inflammatory disease-related costs were also highest for those with incident PsA, and these costs were primarily pharmacy-related. This result complements those reported by Burgos-Pol et al., who also reported higher costs for patients with PsA compared to PSO, driven primarily by pharmacy-related costs [13].

This study demonstrated that patients with multiple CID diagnoses experience high treatment utilization, HCRU, and healthcare costs. Patients with axSpA + PsA, axSpA + HS, and HS + PSO showed high proportions of treatment use, with particularly high opioid and corticosteroid use across subgroups and across the BL and FU periods. Patients with axSpA + PsA and axSpA + HS showed higher proportions of oral steroid use compared to topical steroid use; however, the opposite was true for patients with HS + PSO.

Increases in costs were observed for patients with axSpA + PsA, axSpA + HS, and HS + PSO from the BL period to the FU period. Particularly for patients with axSpA + PsA, inflammatory disease-related costs accounted for much of the total all-cause healthcare costs. Across all groups, increases in overall costs from the BL period to the FU period were largely driven by increases in inflammatory disease-related pharmacy costs. The proportions of patients using

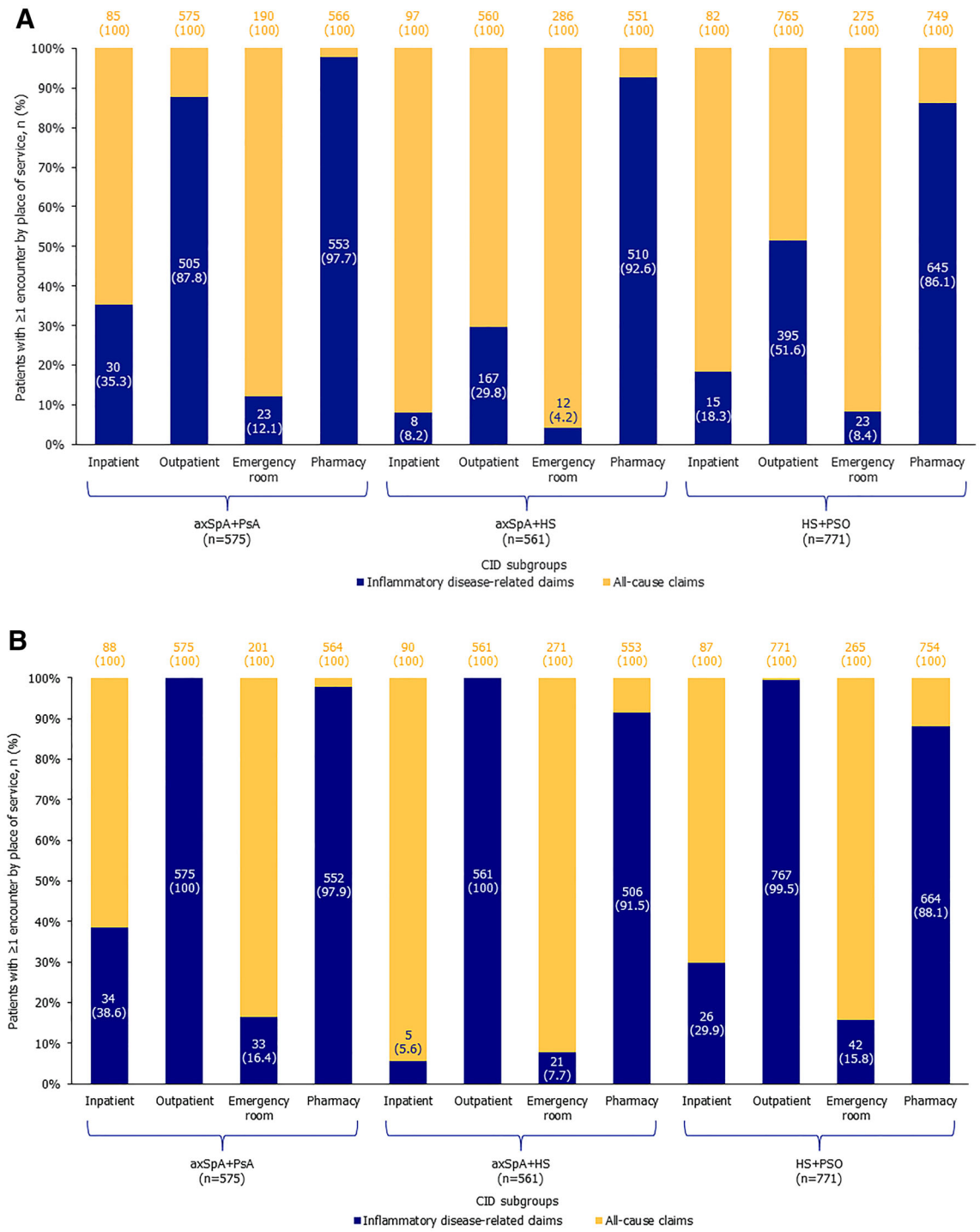

Fig. 4 Patients with one or more inflammatory disease-related encounters as a proportion of all-cause encounters by place of service among patients with selected past additional CID diagnoses in **A** baseline and **B** follow-up periods. *axSpA* axial spondyloarthritis, *CID* chronic inflammatory disease, *HS* hidradenitis suppurativa, *PsA* psoriatic arthritis, *PSO* psoriasis

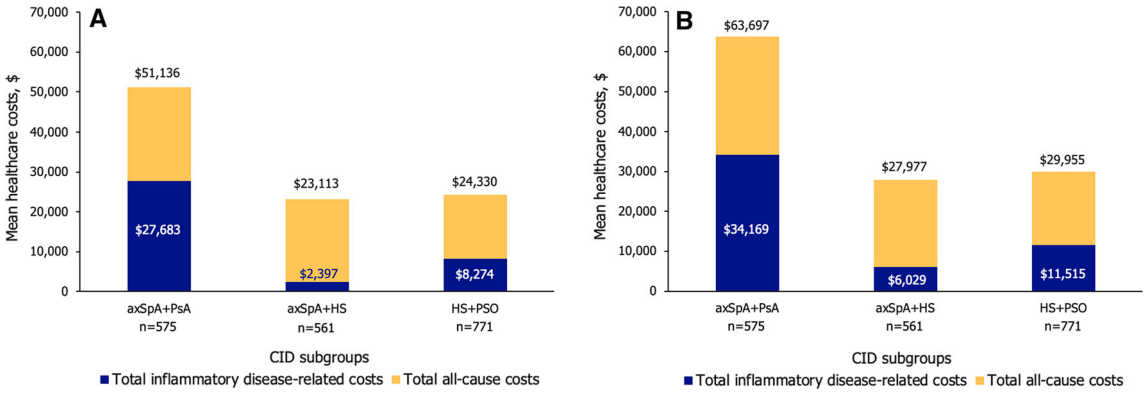

Fig. 5 Inflammatory disease-related costs as a subset of all-cause costs among patients with selected past additional CID diagnoses in **A** baseline and **B** follow-up periods. *axSpA* axial spondyloarthritis, *CID* chronic inflammatory disease, *HS* hidradenitis suppurativa, *PsA* psoriatic arthritis, *PSO* psoriasis

biologic DMARDs and corresponding mean number of DMARD pharmacy claims also increased from the BL period to the FU period and could account for some of the increased cost. Biologic use has previously been found to be associated with higher all-cause costs in patients with AS (r-axSpA) and PsA [34]. It is important to note that axSpA with additional PsA diagnosis is rare, and these patients may have a single disease that has a challenging presentation to diagnose. Furthermore, this cohort was significantly impacted from both a clinical and cost perspective, thus more proactive treatment within the spondyloarthropathy spectrum may be warranted.

To our knowledge, healthcare costs in the three cohorts of patients with CIDs that we investigated have not been previously analyzed, but prior studies characterizing the economic burden of patients with a past diagnosis of PSO and newly diagnosed PsA similarly found higher outpatient and pharmacy costs compared to patients diagnosed with PSO alone [35, 36]. An analysis of claims data comparing patients with AS (r-axSpA) to matched non-AS controls found that increased healthcare costs for patients with AS (r-axSpA) were largely driven by increased outpatient and pharmacy costs, similar to what we found for patients with incident axSpA in this study [20]. Additionally, studies of HCRU and costs in HS are scarce, with none to our knowledge accounting for CID diagnoses, but one study which examined claims prior to biologic treatment approval found increased outpatient costs after diagnosis [37].

Limitations

This study is subject to a number of limitations. The majority of patients represented in the MarketScan® database are commercially insured, thus the findings from this study may not be generalizable to populations with other insurance plans or without insurance. Within commercial plans, variability in coverage is expected; however, this information cannot be determined from the available database records. Furthermore, patients were required to meet pre-index and post-index enrollment criteria, and therefore results from this study may not generalize to patients with shorter coverage due to disenrollment or death.

Additionally, as with any claims data analysis, the present study was based on the measures in the database to evaluate patient, disease, and treatment characteristics, as well as the resource use and cost information in the BL and FU periods. Any miscoding of diagnoses or treatments would affect results. Any patients with PSO, PsA, axSpA, or HS who remained undiagnosed or did not meet the inclusion criteria would not have been included in this study. Moreover, some patients were identified as

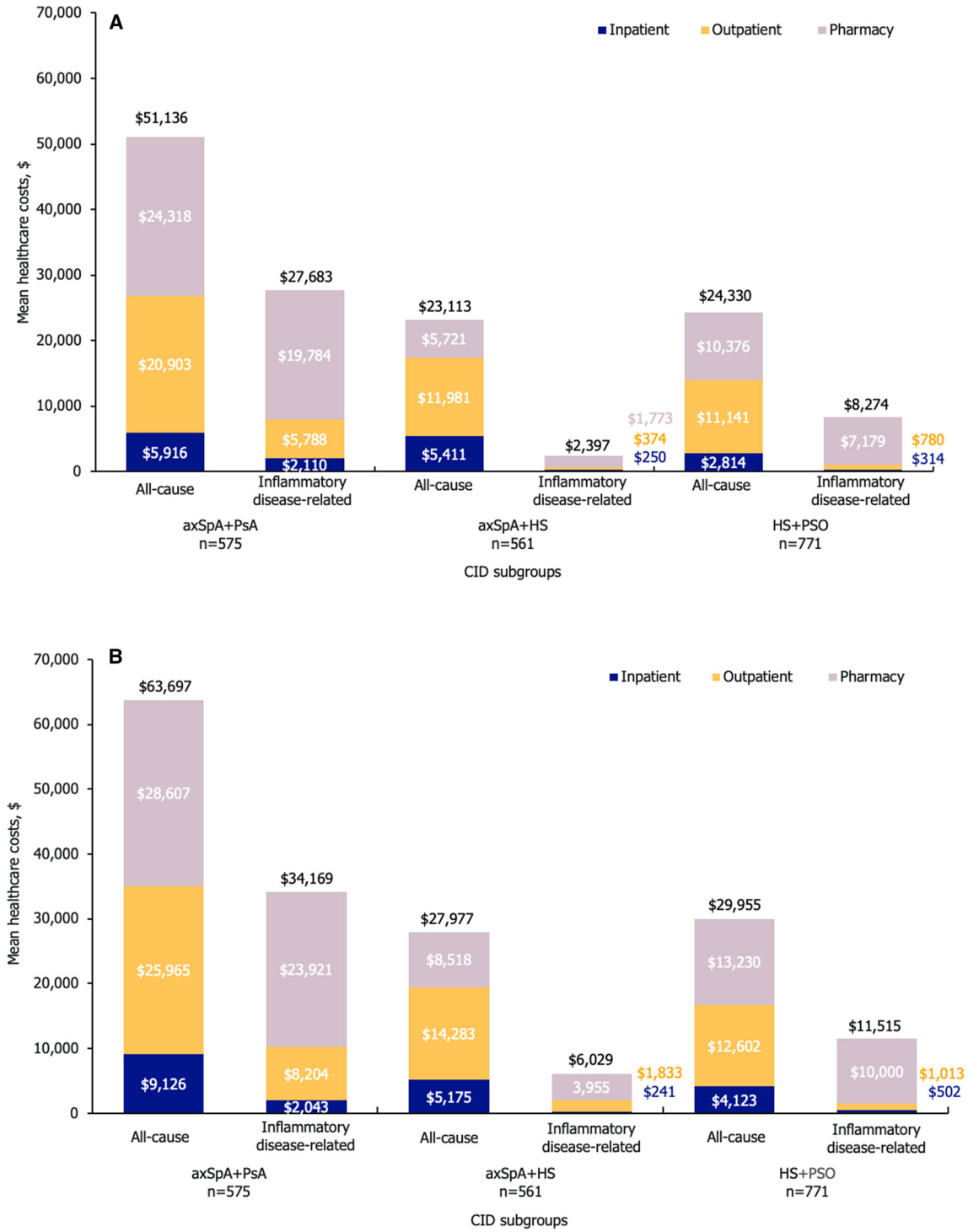

Fig. 6 All-cause and inflammatory disease-related costs by HCRU type among patients with selected past additional CID diagnoses in **A** baseline and **B** follow-up periods. *axSpA* axial spondyloarthritis, *CID* chronic inflammatory disease, *HS* hidradenitis suppurativa, *PsA* psoriatic arthritis, *PSO* psoriasis

having simultaneous diagnoses of both axSpA and PsA, the dual occurrence of which is clinically unlikely because of overlapping symptom profiles [38, 39]. However, since these conditions fall under the family of spondyloarthritis and because symptoms are heterogenous and tend to evolve over time, initial diagnosis may be challenging and a second diagnosis may occur as more symptoms emerge [38]. As a result of the design of this study, dual diagnoses that resulted from the evolution of an initial singular diagnosis versus diagnostic uncertainty could not be differentiated. Algorithms prioritizing specificity of exposure definition were used in the definitions of PsA and axSpA in this study, each of which required two claims with the corresponding diagnoses. These definitions were selected to prioritize specificity of definition for conditions in which initial diagnosis is challenging.

Finally, the database used in this study consists of adjudicated claims used to facilitate payment; while coding errors are likely rare, claims that facilitate payment are more likely to be present and complete in the data. While important patient-centered factors such as disease severity are related to healthcare costs, these were not captured in the database. To a similar effect, MarketScan® data capture medications that were dispensed to patients and billed to payers; the fact that the patient received the medication does not ensure that the patient took the medication. Additionally, over-the-counter medication use and medications administered during hospitalizations were not captured.

CONCLUSIONS

This study demonstrates that patients with a newly diagnosed CID and additional past diagnosis of PSO, PsA, axSpA, or HS experience increased proportions of treatment utilization and high healthcare costs from the year prior to diagnosis of their index disease to the year following their diagnosis. These findings highlight the need for payers, health technology assessment agencies, clinicians, and other stakeholders to explore co-management of CIDs as opposed to treating them as separate entities and increase awareness of symptoms for conditions in the spondyloarthropathy spectrum to lower occurrences of early misdiagnoses.

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Disclosures. Sari Hopson: Employee of Bristol Myers Squibb, former employee of UCB Pharma; Liza R. Gibbs, Sahar Syed: Employees and stockholders of Aetion, Inc; Robert Low, Laura McClung, Silky Beaty: Employees and stockholders of UCB Pharma.

Compliance with Ethics Guidelines. MarketScan® is Health Insurance Portability and Accountability Act (HIPAA) compliant. As patient data were de-identified, the use of these data does not constitute human subject

research and does not require approval from an institutional review board.

Data Availability. Data from non-interventional studies are outside of UCB's data sharing policy and are unavailable for sharing.

Prior Presentation. This study was presented in part at ISPOR 2022, May 14–18, 2022, Washington, D.C., USA. Poster no. EE390 [40].

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