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Journal
Dermatology Online Journal, 27(1)

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Publication Date
2021

DOI
10.5070/D3271052018

Real-world biologic and apremilast treatment patterns and healthcare costs in moderate-to-severe plaque psoriasis

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Abstract

Plaque psoriasis is a chronic disease requiring long-term therapy. However, long-term real-world treatment patterns and costs are not well characterized. This study examined treatment patterns and healthcare costs among patients newly initiating a biologic or apremilast for moderate-to-severe plaque psoriasis. Included patients had ≥1 prescription for secukinumab, ixekizumab, adalimumab, ustekinumab, etanercept, or apremilast between 01/01/2015 and 08/31/2018, no prior use of the index medication, and continuous enrolment 12 months pre-index and 24 months post-index. Treatment adherence, non-persistence, discontinuation, switching, use of combination therapy, and re-initiation were assessed at 12, 18, and 24 months post-index. In addition, total and psoriasis-related healthcare costs were evaluated at 24 months. A total of 7,773 patients with 24-month follow-up were included. Overall, adherence was low (21.3%–33.5%) and non-persistence was high (58.4%–86.5%) over 24 months. Discontinuation (38.4%–51.3%), switching (29.7%–52.6%), combination therapy (27.6%–42.9%), and re-initiation of the index medication (19.3%–44.5%) were common. Healthcare costs were high and mostly contributed by psoriasis treatment. Therefore, maintaining disease control on long-term therapy is still challenging for many patients.

Keywords: psoriasis, biologic therapy, apremilast, treatment patterns

Introduction

Plaque psoriasis is a chronic immune-mediated disease with substantial morbidity and mortality [1]. Approximately 7.4 million adults are estimated to have psoriasis in the U.S. [2], with 1.7 million having moderate-to-severe disease [3]. It has an extensive psychosocial and emotional effect on patients and is consequently associated with decreased health-related quality of life, with greater impairment seen in patients with more extensive skin involvement [4,5]. In addition, psoriasis is associated with an elevated risk of a range of comorbidities including psoriatic arthritis (PsA), diabetes, and cardiovascular disease, which may reduce patients' life expectancy [5-7].

Psoriasis is an incurable disease with a chronic relapsing course, and most patients will require long-term treatment [8]. As a result, psoriasis constitutes a significant economic burden to both patients and society. In 2013, the estimated annual cost of psoriasis to the US was $135 billion when direct, indirect, and comorbidity-related costs were taken into account [9]. Studies have demonstrated that disease severity correlates with both direct and indirect costs, with patients with moderate-to-severe psoriasis having more clinic visits, higher treatment costs, and more days of work missed annually compared with patients with mild psoriasis [5].

Current treatment guidelines recommend traditional oral systemic agents (e.g., methotrexate, acitretin, and cyclosporine), biologic therapies (e.g., anti-tumor necrosis factor agents and antibodies that target interleukin (IL)12/23, IL17, IL17R, or IL23, or the phosphodiesterase-4 inhibitor apremilast for the treatment of moderate-to-severe disease. Many different biologic therapies, as well as apremilast, are

now available and widely used for the treatment of moderate-to-severe psoriasis in the U.S. [6,10-12]. Although these drugs have revolutionized the treatment of this disease over the past decade, some patients do not respond, only partially respond, or lose their response to treatment over time [1,6]. These therapies are also associated with the risk of a variety of adverse events (AEs) and can be limited by inconvenient administration methods or the need for frequent dosing [6,12]. Consequently, high levels of patient dissatisfaction continue to be reported and patients with psoriasis tend to cycle through many treatment options during the course of their disease, with low rates of adherence and persistence and high rates of switching therapy, discontinuing therapy, and combining therapies observed in previous studies [3,6,13,14].

Real-world data on treatment patterns and associated costs in patients with psoriasis are scarce. In particular, long-term treatment patterns are not well characterized, with the majority of US studies to date only examining patients over a period of 12 months [12,14]. Given the high costs associated with biologic treatment, the chronic nature of psoriasis, and the lack of clear guidelines to help clinicians choose the optimal treatment for their patients, the long-term usage patterns and healthcare costs of these agents in the real-world setting have important implications for both clinicians and payers. The objective of the current study was to examine the real-world treatment patterns and costs among U.S. patients with psoriasis who newly initiated a biologic or apremilast over a 24-month period.

Methods

Data source

This was a retrospective cohort study conducted using medical and pharmacy claims data from the IBM MarketScan Commercial and Medicare Supplemental Databases. The MarketScan databases include the patient-level paid and adjudicated medical and pharmacy claims and included approximately 25 million subscribers in 2017. The databases capture the full continuum of care in all settings, including physician office visits, hospital stays, and outpatient prescription pharmacy claims.

All patient records were de-identified and fully compliant with the U.S. patient confidentiality requirements (the Health Insurance Portability and Accountability Act, 1996).

Patient selection

Patients were included in the study if they had at least one pharmacy claim for secukinumab, ixekizumab, adalimumab, ustekinumab, etanercept, or apremilast between January 1, 2015, and August 31, 2018. The index date was defined as the date of the first prescription for a study drug (the index medication). Patients were required to have at least one diagnosis of psoriasis (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 696.1; International Classification of Diseases, Tenth Revision, Clinical Modification [ICD-10-CM] code L40.x) between January 1, 2011, and the index date. Patients were assigned to one of six mutually exclusive treatment cohorts based on their index medication.

Included patients were aged ≥18 years and had continuous medical and pharmacy benefits over the 12-month pre-index and 24-month post-index periods. Patients in the ixekizumab cohort were only followed for 12 months post-index owing to small sample size. Patients were excluded if they had a diagnosis of human immunodeficiency virus infection (ICD-9-CM codes 42, 79.53, and V08; ICD-10-CM codes B20, B97.35, and Z21) or cancer (ICD-9-CM codes 140.x-238.x; ICD-10-CM codes C00.x-D47.x) at any time during the 12-month pre-index period. To ensure that the cohorts were comprised of patients newly treated with the index medication, patients could not have any claim for the index medication during the 12-month pre-index period.

Outcomes and Measures

Demographic characteristics (e.g., age, gender) were assessed on the index date. Common comorbidities (e.g., coronary heart disease, diabetes, PsA) and use of select medications were identified during the 12-month pre-index period.

Total and psoriasis-related healthcare costs were calculated as reimbursed amounts from payers over

the 24-month study period. Healthcare costs included inpatient costs, outpatient costs, and pharmacy costs and were adjusted to 2018 U.S. dollars based on the medical care component of the Consumer Price Index.

The treatment pattern outcomes examined included adherence, non-persistence, discontinuation, switching, use of combination therapy, and re-initiation. Treatment adherence was calculated according to the proportion of days covered (PDC), which was calculated by dividing the number of days the refill claims should "cover" by the number of days in the observation period [15]. Patients were considered to be treatment adherent if they had a PDC of ≥0.8 [16,17]. The other outcomes were determined based on treatment gaps, defined as the number of days between the previous days' supply being exhausted and the next claim for the index medication. Permissible treatment gaps were based on the literature [12] and expert opinion and were defined as four weeks for etanercept and apremilast, 8 weeks for adalimumab, 10 weeks for secukinumab and ixekizumab, and 18 weeks for ustekinumab. Non-persistence was defined as the presence of a treatment gap exceeding the permissible gap. Discontinuation was defined as the presence of a treatment gap exceeding the permissible gap and no subsequent claim for the index medication during the follow-up period. Re-initiation was defined as the presence of a treatment gap exceeding the permissible gap before a subsequent claim for the index medication. Switching was defined as follows: 1) the index medication was a biologic or apremilast and the patient had a subsequent claim for a different study biologic at any time, or 2) the index medication was a biologic or apremilast and the patient had a subsequent claim for an oral systemic therapy or apremilast (when the index medication was a biologic) following a treatment gap. Use of combination therapy was defined as follows: 1) the patient was on a biologic treatment and had a subsequent claim for apremilast or another oral systemic therapy during the biologic treatment episode, or 2) the patient was on apremilast and had a subsequent claim for another oral systemic therapy during the apremilast treatment episode. For the purposes of these analyses, other systemic oral therapies included acitretin, isotretinoin capsules, cyclosporine, methotrexate, methoxsalen, 6-mercaptopurine, prednisone, methylprednisolone, dexamethasone, hydroxyurea, thioguanine, sulfasalazine, tacrolimus, mycophenolate mofetil, leflunomide, and azathioprine. All treatment pattern outcomes were measured from the index date to 12, 18, and 24 months of follow-up. The ixekizumab cohort was included in the 12-month analyses only owing to small sample size for longer follow-up periods.

Statistical Analyses

Descriptive statistics were provided for demographic and clinical characteristics, treatment pattern outcomes, and costs. Continuous variables were presented as means, medians, and standard deviations, and categorical variables were presented as frequency counts and percentages. The times from treatment initiation to discontinuation, switching, and use of combination therapy were examined for each treatment cohort using Kaplan-Meier time-to-event curves. Descriptive analyses were conducted using SAS version 9.04, while Kaplan-Meier analyses were conducted using R version 3.6.1.

Results

Patient Characteristics

A total of 7,773 patients with 24-month follow-up were included. Among these patients, 275 received secukinumab, 2,684 received adalimumab, 910 received ustekinumab, 1,063 received etanercept, and 2,841 received apremilast at index. An additional 98 patients were included in the ixekizumab cohort for the12-month analyses. The mean age ranged from 46.5 to 49.7 years and 45.9%–54.9% of patients were female (**Table 1**).

Comorbidities were common, with the highest percentages of patients presenting with PsA (16.3%–45.7%), hypertension (28.6%–38.9%), and hyperlipidemia (27.0%–32.0%). Medications for comorbidities (such as cardiovascular drugs/antihypertensives, and antidepressants), as well as other psoriasis-related prescriptions (such as methotrexate and topical and systemic steroids),

Table 1. *Patient demographic and clinical characteristics.*

Characteristic	Secukinumab (N=275)	Ixekizumab (N=98)[a]	Adalimumab (N=2684)	Ustekinumab (N=910)	Etanercept (N=1063)	Apremilast (N=2841)
Age, years, mean±SD	49.4±11.3	46.9±11.5	46.7±11.9	46.5±12.7	48.0±11.6	49.7±12.3
Female	132 (48.0)	45 (45.9)	1364 (50.8)	446 (49.0)	561 (52.8)	1561 (54.9)
Comorbidities						
Anxiety	18 (6.5)	15 (15.3)	111 (4.1)	32 (3.5)	41 (3.9)	117 (4.1)
CHD	27 (9.8)	7 (7.1)	197 (7.3)	88 (9.7)	90 (8.5)	278 (9.8)
Diabetes	57 (20.7)	11 (11.2)	351 (13.1)	119 (13.1)	139 (13.1)	420 (14.8)
Hyperlipidemia	87 (31.6)	28 (28.6)	747 (27.8)	246 (27.0)	295 (27.8)	908 (32.0)
Hypertension	107 (38.9)	28 (28.6)	860 (32.0)	294 (32.3)	351 (33.0)	1051 (37.0)
Obesity	66 (24.0)	15 (15.3)	465 (17.3)	152 (16.7)	199 (18.7)	487 (17.1)
Psoriatic arthritis	97 (35.3)	16 (16.3)	943 (35.1)	200 (22.0)	486 (45.7)	704 (24.8)
Rheumatoid arthritis	19 (6.9)	1 (1.0)	150 (5.6)	29 (3.2)	93 (8.7)	94 (3.3)
Medications						
Antidepressants	95 (34.5)	27 (27.6)	755 (28.1)	238 (26.2)	337 (31.7)	812 (28.6)
Biologics other than index	64 (23.3)	0	93 (3.5)	155 (17.0)	54 (5.1)	203 (7.1)
CV drugs/ antihypertensives	147 (53.5)	45 (45.9)	1183 (44.1)	404 (44.4)	513 (48.3)	1435 (50.5)
Methotrexate	59 (21.5)	10 (10.2)	796 (29.7)	147 (16.2)	294 (27.7)	395 (13.9)
Systemic steroids	86 (31.3)	29 (29.6)	931 (34.7)	216 (23.7)	374 (35.2)	843 (29.7)
Topical steroids	205 (74.5)	75 (76.5)	1949 (72.6)	670 (73.6)	704 (66.2)	2278 (80.2)
Total healthcare costs in the 12-month pre-index period, mean±SD[b]						
Inpatient	$1,751± $9,461	$4,450± $26,794	$1,803± $10,859	$2,602± $18,770	$1,913± $9,679	$2,561± $13,973
Outpatient	$12,382± $25,578	$7,044± $21,651	$5,763± $15,351	$7,096± $14,127	$6,737± $13,191	$6,735± $21,752
Pharmacy	$15,381± $26, 195	$6,735± $14,043	$4,713± $10,423	$8,736± $17,396	$5,268± $11,038	$6,593± $11,657
Total	$29,514± $39,792	$18,229± $40,516	$12,279± $23,127	$18,434± $31,970	$13,918± $21,440	$15,888± $31,327

Data presented as N (%) unless otherwise noted.
[a]Patient characteristics are provided for the 98 ixekizumab patients who had 12-month post-index follow-up period; for all other treatment cohorts the characteristics are for patients with 24-month of post-index follow-up.
[b]Costs were adjusted to 2018 US dollars.
Abbreviations: CHD, coronary heart disease; CV, cardiovascular; SD, standard deviation.

were common at baseline. Higher proportions of patients in the secukinumab and ustekinumab cohorts had prior exposure to biologics (17.0%–23.3% versus 0%–7.1% in other cohorts). During the 12-month pre-index period, patients incurred high healthcare costs, which were mainly composed of pharmacy costs (36.9%–52.1%) and outpatient costs (38.5%–48.4%).

Costs

Over the 24-month follow-up period, patients in all treatment cohorts incurred substantial total healthcare costs, with the mean cost being highest for secukinumab at $125,468 and lowest for apremilast at $75,665 (**Table 2**). Most of these costs (67.4%–80.8%) were related to psoriasis treatment. For both total healthcare costs and psoriasis-related

Table 2. *Total and psoriasis-related healthcare costs over the 24-month follow-up period.*

	Secukinumab (n = 275)	Adalimumab (n = 2,684)	Ustekinumab (n = 910)	Etanercept (n = 1,063)	Apremilast (n = 2,841)
Total healthcare costs					
Inpatient	$5,264 ± $22,104	$5,278 ± $25,351	$6,236 ± $38,153	$5,448 ± $21,531	$5,808 ± $29,943
Outpatient	$13,523 ± $28,943	$13,254 ± $39,571	$18,512 ± $40,440	$12,199 ± $25,973	$12,985 ± $30,358
Pharmacy	$106,681 ± $54,880	$86,892 ± $50,599	$95,254 ± $59,601	$88,787 ± $48,578	$56,873 ± $42,778
Total	$125,468 ± $68,825	$105,423 ± $68,785	$120,002 ± $79,823	$106,434 ± $62,632	$75,665 ± $64,428
Psoriasis-related healthcare costs					
Inpatient	$313 ± $4684	$26 ± $830	$0 ± $0	$15 ± $371	$16 ± $652
Outpatient	$1,235 ± $3,552	$1,698 ± $18,517	$7,524 ± $29,885	$1,275 ± $5,612	$1,486 ± $7,196
Pharmacy	$94,625 ± $42,340	$81,181 ± $48,868	$89,418 ± $56,712	$81,653 ± $46,029	$49,533 ± $35,806
Total	$96,174 ± $42,862	$82,905 ± $51,381	$96,943 ± $56,387	$82,944 ± $46,036	$51,035 ± $36,448

Data presented as mean ± SD. Costs were adjusted to 2018 US dollars.

costs, pharmacy costs were the main cost driver (75.2%–85.0% of total healthcare costs and 97.1%–98.4% of psoriasis-related costs), followed by outpatient costs, and then inpatient costs.

Treatment Patterns

The majority of patients were non-persistent over 24 months (58.4%–86.5%), with the median time to non-persistence ranging 117–208 days. Adherence rates were low over the 24-month follow-up period: secukinumab, 33.5%; adalimumab, 27.1%; apremilast, 22.8%; ustekinumab, 22.5%; and etanercept, 21.3% (**Figure 1**). The median PDC over the study period was 0.37–0.58. Almost half the patients discontinued their index medication over 24 months, with patients on adalimumab having the highest discontinuation rate (51.3%), followed by secukinumab (47.6%), apremilast (44.5%), etanercept (42.1%), and ustekinumab (38.4%). Median time to discontinuation ranged from 113 days for the apremilast cohort to 254 days for the secukinumab cohort. Switching was common in all cohorts (etanercept, 52.6%; apremilast, 45.3%; secukinumab, 45.1%; adalimumab, 44.9%; and ustekinumab, 29.7%). Patients were treated with their index medication for a median of 280–368 days before switching to another treatment.

Use of combination therapy was common in all treatment cohorts, with rates ranging from 27.6%–42.9%. The median time to combination therapy use was as short as 61 days in the etanercept cohort and was longest in the ustekinumab cohort (139 days). Rates of re-initiation varied by treatment, from 19.3%

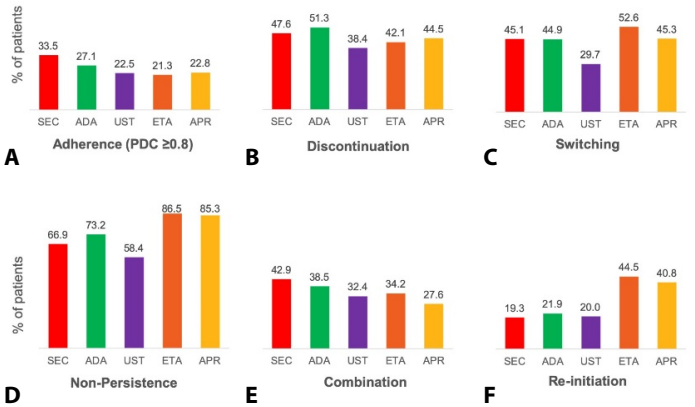

Figure 1. *Patient **A)** adherence, **B)** discontinuation, **C)** switching, **D)** non-persistence, **E)** use of combination therapy, and **F)** re-initiation over 24 months of follow-up. ADA, adalimumab; APR, apremilast; ETA, etanercept; IXE, ixekizumab; PDC, proportion of days covered; SEC, secukinumab; UST, ustekinumab.

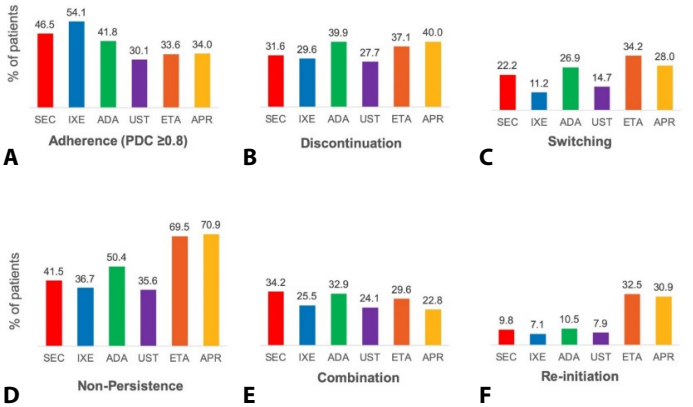

Figure 2. *Patient **A)** adherence, **B)** discontinuation, **C)** switching, **D)** non-persistence, **E)** use of combination therapy, and **F)** re-initiation over 12 months. ADA, adalimumab; APR, apremilast; ETA, etanercept; IXE, ixekizumab; PDC, proportion of days covered; SEC, secukinumab; UST, ustekinumab.

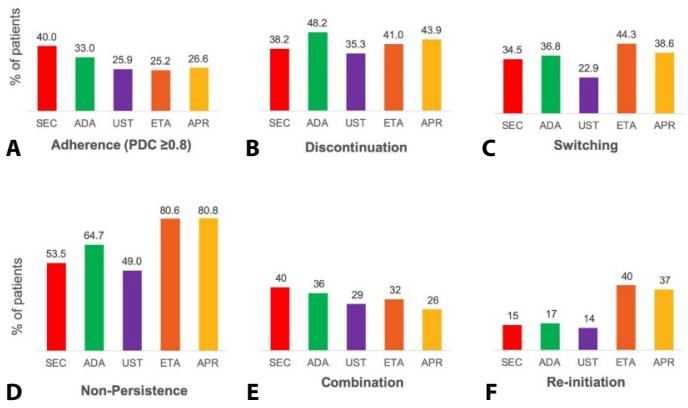

Figure 3. *Patient **A)** adherence, **B)** discontinuation, **C)** switching, **D)** non-persistence, **E)** use of combination therapy, and **F)** re-initiation over 18 months. ADA, adalimumab; APR, apremilast; ETA, etanercept; IXE, ixekizumab; PDC, proportion of days covered; SEC, secukinumab; UST, ustekinumab.*

in the secukinumab cohort to 44.5% in the etanercept cohort. The median time to re-initiation was 50–195 days. Similar trends were observed over the 12-month and 18-month follow-up periods (**Figures 2, 3**), with longer follow-up duration correlating with worse outcomes across the treatment cohorts.

The Kaplan-Meier time-to-event curves confirmed these results (**Figure 4**). The probabilities of discontinuation, switching, and use of combination therapy increased over time in all treatment cohorts. Ustekinumab patients had the lowest probability of discontinuation over 24-month follow-up; apremilast patients had the highest probability of discontinuation over the first 6–9 months, after which the probability for adalimumab became the highest. Ixekizumab and ustekinumab patients were least likely to switch treatments at all timepoints, whereas etanercept patients were most likely to switch; the probabilities of switching did not reach a plateau by 24-month follow-up.

Discussion

Using a large U.S. administrative claims database, this study examined real-world treatment patterns and healthcare costs among moderate-to-severe plaque psoriasis patients newly initiating biologics and apremilast. Over the 24-month follow-up period, adherence rates were low, whereas rates of non-persistence, discontinuation, switching, use of combination therapy, and re-initiation were high. Total and psoriasis-related healthcare costs were also substantial across the treatment cohorts, mainly driven by pharmacy costs.

Because plaque psoriasis is a lifelong disease, understanding the treatment patterns in patients in real-world clinical practice over the long term is critical. To our knowledge, this is the first real-world analysis of treatment patterns in this population over a 24-month follow-up period. By examining treatment patterns over a period longer than 12 months, we were able to show that all the examined outcomes became progressively worse over time. Although biologics and apremilast are highly effective therapies that have improved the prognosis for patients with plaque psoriasis, our findings contribute to a growing literature indicating that adherence and persistence with these therapies may still be a problem over the long term [12,14].

Adherence, as measured by PDC, is relatively objective and not impacted by our study assumptions, so it may be the most accurate measure of real-world treatment usage. Although previous studies have found that adherence rates for biologics tended to be higher than for traditional psoriasis therapies [6], the adherence rates in this study were strikingly low across the treatment cohorts, with less than one-third of patients being adherent over 24 months. Non-adherence could be due to many factors stemming from the patient, healthcare provider, or insurance coverage. However, the World Health Organization has recognized therapeutic adherence in chronic diseases as one of the most important factors for effective therapy [18]. Patients who do not use their treatment as prescribed incur the risk of undertreatment and inefficacy, which may lead to poor disease control and treatment failure. The risk of AEs is also higher in patients receiving biologics intermittently rather than continuously [8,19]. Thus, the poor adherence rates in the current study may partially explain the progressively worse treatment pattern outcomes observed over time.

Rates of discontinuation and switching were high and generally higher in our study compared with

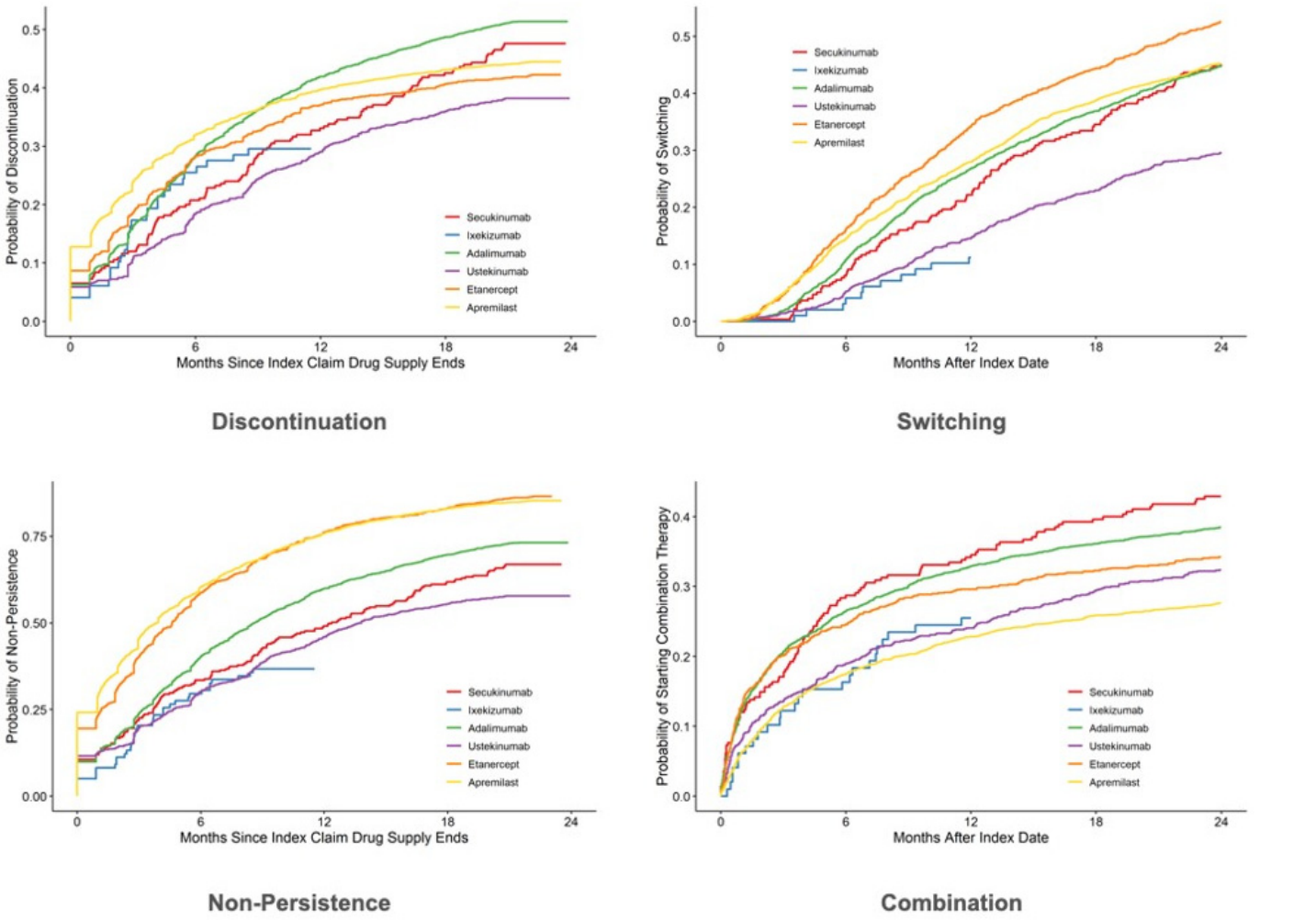

Figure 4. *Kaplan–Meier curves for **A)** discontinuation, **B)** switching, **C)** non-persistence, and **D)** use of combination therapy over the 24-month follow-up period. Owing to data availability, ixekizumab was only analyzed at 12-month post-index.*

previous studies in U.S. psoriasis patients with shorter follow-up periods [12,14]. Reasons for discontinuing or switching therapy may include lack of efficacy, loss of response over time, intolerance or AEs, inconveniently frequent dosing schedules, and drug affordability and availability issues [2,12,13,20,21]. Thus, our findings suggest that many psoriasis patients may be dissatisfied with their treatments, particularly over the long term. Rates of combination therapy were also high at all time points in all treatment cohorts. As the primary reason for augmenting therapy is inadequate response [21], our results indicate that many patients may not be on the optimal treatment for long-term disease control.

In this 24-month study, all treatment pattern outcomes grew progressively worse over time across the treatment cohorts. This suggests that issues such as loss of efficacy and patient dissatisfaction may increase or accumulate over time. Overall, it appears that the unmet need in this population remains high despite the availability of many treatment options.

In a recent 2-year Danish registry study of patients on etanercept, infliximab, adalimumab, ustekinumab, and secukinumab, drug survival was lowest for secukinumab and highest for ustekinumab [22]. Our results are broadly consistent with these findings, with ustekinumab having the lowest and adalimumab and secukinumab having the highest discontinuation rates, although the discontinuation rate for ustekinumab was still substantial at almost 40% at 24 months. Patients on ustekinumab, an anti-IL12/23 agent, were also less likely to switch therapy in our study and had better persistence than patients

who initiated other treatments at all time points, possibly owing to its safety profile and dosing schedule.

The costs observed in our study are consistent with previous studies showing that plaque psoriasis is a burdensome disease associated with high healthcare costs. In a recent analysis, which also used the MarketScan databases (2007–2012), annual total healthcare costs were higher for patients with psoriasis than for those without the disease ($22,713 versus $4,993; P<0.001), [7]. In the current study, we used more recent data and only included patients who initiated a biologic or apremilast; therefore, costs were much higher (up to $125,468 over 24 months), with the majority of the costs contributed by psoriasis-related pharmacy costs.

The suboptimal performance of currently available therapies may play a role in the high costs. Patients with an inadequate response might be more likely to increase the dose of their treatment or—as was seen in our study—add another therapy, both practices that could increase costs [23]. Dissatisfied patients may also be more likely to switch therapy, and switching also incurs higher costs related to the more frequent loading doses required during the induction period. Thus, it is in the best interest of patients with psoriasis that healthcare providers and payers select the optimal treatment option for long-term disease control.

Clearly, remaining on long-term psoriasis treatment is still a challenge for many patients despite the wide range of available treatment options. Since psoriasis is a chronic condition and is associated with an increased risk of cardiovascular disease among other comorbidities, efforts to improve these treatment patterns outcomes are important. Lack of efficacy and presence of AEs are the most common reasons for treatment discontinuation [6,13]. More effective and safe therapies that improve patient satisfaction and adherence to therapy without switching or discontinuation would be welcomed. Psoriasis patients express a preference for drugs that are administered by a healthcare professional and for those with a longer dosing interval [20,24]. Therefore, clinic-administered therapies may also have the potential to improve adherence and persistence.

This study had a number of limitations. Patients were identified through administrative claims data as opposed to medical records, thus miscoding of diagnoses and clinical characteristics cannot be ruled out. Similarly, medication adherence was based on prescription claims and we cannot be certain that filled prescriptions were actually taken as prescribed. In addition, most of the treatment pattern outcomes were based on pre-defined treatment gaps. Owing to the large variation in dosing frequency between the included treatments (twice a day to once every 12 weeks), the results might be biased toward disadvantage for medications with less frequent dosing. More recently approved treatments such as ixekizumab, tildrakizumab, risankizumab, and guselkumab could not be included in the primary analyses because of the lack of 24-month follow-up data. Future studies including newer therapies would be of interest. Finally, although MarketScan is a large database with nationally representative geographic distribution, it is possible that the findings are not generalizable to U.S. psoriasis patients with other types of health insurance coverage or without insurance.

Conclusion

Among patients with moderate-to-severe psoriasis, adherence rates for biologics and apremilast were low, whereas rates of non-persistence, discontinuation, switching, combination therapy, and re-initiation were high. Additionally, healthcare costs driven by psoriasis treatment were high. Overall, maintaining consistent disease control with long-term therapy is a significant challenge for many patients.

Potential conflicts of interest

YZ, JZ, and AMM are/were employees of Sun Pharmaceutical Industries, Inc. DJM, LLG, GS, and EHM are employees of IBM Watson Health and were contracted by Sun Pharmaceutical Industries Inc. to support the study. SRF is a researcher who has received funding from Sun Pharmaceutical Industries, Inc.

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