Characterizing patients with psoriasis on injectable biologics adalimumab, etanercept, and ustekinumab: A chart review study

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Abstract
Objective: This study examined plaque psoriasis (PsO) patient characteristics across injectable biologics. Methods: Data were collected from 400 US dermatologists randomly selecting five charts each for patients with PsO (patient n = 2000): adalimumab (ADA; n = 447), etanercept (ETA; 539), ustekinumab (UST) 45 mg (511) and UST 90 mg (503). Physicians had to have been in practice 2–30 years, managing 10+ patients (5 + with biologics for PsO). Generalized estimating equation models, weighted according to inverse probability of patient selection and accounting for patient correlation within physicians, examined patient measures as a function of treatment (UST 90 mg = reference). Results: Patients on UST 90 mg had higher odds of weighing > 100 kg (adjusted mean = 34.4%) vs. ADA (10.9%), ETA (5.5%) or UST 45 mg (6.8%), greater body surface affected and higher odds of severe PsO prior to treatment and higher odds of prior biologics use. Mean prior biologics used was higher with UST 90 mg versus ADA or ETA. Number of comorbidities was higher with UST 90 mg versus ETA or UST 45 mg. Conclusions: Among biologics-treated patients with PsO, UST 90 mg appears to be used in patients with greater weight, baseline severity and prior biologics experience than ADA, ETA or UST 45 mg. UST 90 mg is used in patients with more comorbidities than other treatments except ADA.

Keywords
Psoriasis, biologics, adalimumab, etanercept, ustekinumab

Introduction
Plaque psoriasis (PsO) is a chronic inflammatory, multisystem disorder with predominantly skin- and joint-related symptoms, affecting approximately 2% of the US population (1). About 20–30% of patients experience a moderate-to-severe condition that affects at least 5% of their body surface area and/or involves areas such as hands, feet, face or genitalia (1) and may require systemic treatments in addition to topical treatments to ameliorate inflammation (2).

Biologic agents have been found to be effective in treating moderate to severe PsO, while often requiring monitoring due to safety concerns or augmenting with combination or adjunctive therapies (3). At the time of the study, the most frequently used biologics in PsO were adalimumab (ADA) and etanercept (ETA), followed by ustekinumab (UST) and least frequently, infliximab, a biologic administered via infusion (4). This study focuses on the three injectable biologics: ADA, ETA and UST. Different from the other two injectable biologics, ustekinumab has a weight-based dosing, where the 90 mg is to be used in patients with a body weight greater than 100 kg and the 45 mg is to be used in patients weighing 100 kg or less (5).

However, little is known about how, at a population level, patients taking these biologics differ in terms of their demographic or health characteristics, including body weight. Therefore, research is needed to better understand whether patients with PsO using UST, particularly the 90 mg dose, differ from those using ADA and ETA in the real world. The objective of this study is to examine the characteristics of patient populations using each of the four biologics treatments (ADA, ETA, UST 45 mg and UST 90 mg), as well as to determine potential drivers of treatment choice.

Methods
Due to the large number of study measures, only measures of interest are reported in the main text. Complete methods are available in the online Appendix.

Sample and source
A total of 400 US dermatologists were asked to pull 2000 PsO patient charts (five per physician) split between those being treated with ADA, ETA, UST 45 mg and UST 90 mg. Participating dermatologists had to meet all of the following inclusion criteria to be eligible for enrollment into the study: (1) Dermatologists have the ability to read and write English. (2) They should be a certified physician specializing in dermatology. (3) They should be board eligible or certified. (4) They have been practicing for 2–30 years, excluding residency and fellowship. (5) They must be managing at least 10 patients with psoriasis. (6) They must be managing at least five PsO patients with biologics.
Each treatment group was compared against the reference group (UST 90 mg). There was evidence of at least moderate intraclass correlations (ICCs) on some measures, and therefore, generalized estimating equation (GEE) models were used to examine individual patient characteristics (e.g. weight, age, gender) as a function of treatment groups (either ADA, Eta or UST 45 mg vs. UST 90 mg as the reference group). These models controlled simultaneously for any covariates; however, no covariates were entered for the “adjusted bivariate” analyses associated with the primary objective. These could be normal or binary logistic models, with the outputs providing Bs (betas) for normal distribution models or ORs (odds ratios) for binary logistic models, and estimated means/proportions and 95% confidence intervals. GEE clusters were the groups of patients within physicians. The models were fit under the assumption of compound symmetry error structures.

Secondary objective: examining potential predictors of treatment choice

Multivariable analysis was used to assess whether variables were independent predictors of treatment choice: three binary logistic GEE models predicting UST 90 mg versus either (1) UST 45 mg, (2) ETA or (3) ADA. As noted previously, with likely dependencies in the data, the multivariable model for the secondary objective was run with the same considerations as for the models used with the primary objective.

Covariates were selected according to several considerations (e.g. assessment of multicollinearity, preference for combined vs. low-prevalence and/or individual measures), with no more than 10–20 chosen for a given model. Although this was a cross-sectional study, covariates were only selected if they were likely candidates as causal predictors (e.g. exogenous variables), not consequences (e.g. current disease severity), of the outcome measures (i.e. treatment group). Stepwise backward elimination was used with a simpler multinominal logistic GLM to help winnow the final remaining covariates list to a more manageable size including only significant contributors to the model fit.

Results

Due to the large number of study measures, only findings of interest were reported in the main text and tables. The complete results are available in the online Appendix.

Sample description

The final sample included 400 unique (sampled without replacement) dermatologists out of 11821 invited from across two panels, with a 3.5% response rate (after accounting for 354 physicians who were screened out based on exclusion criteria). Study recruitment was terminated at 400 physicians; therefore, the overall potential response rate among invitees is unknown. Charts were pulled for 2000 patients in total: 447 on ADA (22.4%), 539 on ETA (27.0%), 511 on UST 45 mg (25.6%) and 503 on UST 90 mg (25.2%). Physicians were 66.3% male, 87.8% between 35–64 years old, 32.0% practicing in a major metropolitan area, and 51.5% in private group practice (results not shown). Physicians reported treating on average 91.6 (SD 112.7) plaque PsO patients, with Eta prescribed to 31.6%, UST 45 mg to 16.0% and UST 90 mg to 12.0%.

Statistical analyses

Primary objective: understanding the characteristics of the patient populations of each treatment group

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Statistical analyses

Primary objective: understanding the characteristics of the patient populations of each treatment group.
Table 1. Patient demographic and weight characteristics, comparing etanercept versus ustekinumab 90 mg, adalimumab versus ustekinumab 90 mg and ustekinumab 45 mg versus ustekinumab 90 mg treatment groups (weighted and accounting for physician effects).

| Variable                      | Mean/% (LCL-95% UCL-95%) | Mean/% (LCL-95% UCL-95%) | Mean/% (LCL-95% UCL-95%) | Mean/% (LCL-95% UCL-95%) |
|-------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Age                           |                           |                           |                           |                           |
| 18–39                         | 48.94 (47.03–50.85)       | 48.20 (45.83–50.57)       | 48.60 (45.91–49.70)       | 48.27 (46.38–50.17)       |
| 40–49                         | 23.88% (17.68–31.42%)     | 24.74% (18.13–32.81%)     | 25.49% (19.60–32.44%)     | 21.74% (16.10–26.89%)     |
| 50–59                         | 32.37% (25.23–40.44%)     | 31.51% (24.46–39.54%)     | 34.55% (26.06–44.15%)     | 33.76% (25.35–43.34%)     |
| 60–69                         | 24.68% (18.93–31.51%)     | 24.17% (17.49–32.40%)     | 18.86%a (14.24–24.54%)    | 29.54% (22.60–37.57%)     |
| 70–89                         | 4.52% (2.01–9.82%)        | 5.56% (3.08–9.66%)        | 18.24% (12.22–26.34%)     | 10.62% (7.10–15.61%)      |
| Gender (male)                 | 60.46% (52.97–67.49%)     | 65.53% (58.04–72.33%)     | 59.81% (51.57–67.52%)     | 66.90% (58.98–73.97%)     |
| Height: inches                | 68.04 (67.45–68.63)       | 68.71 (68.09–69.34)       | 67.55a (66.94–68.16)      | 68.52 (67.87–69.18)       |
| Weight (pounds)               | 168.06a (161.66–174.47)   | 181.60a (173.06–190.14)   | 169.49a (163.33–175.65)   | 207.36 (200.14–214.57)    |
| Weight                       |                           |                           |                           |                           |
| Not known (vs. known)         | 15.73%* (11.31–21.45%)    | 19.96%* (14.98–26.09%)    | 15.46%* (9.99–23.16%)     | 9.91% (6.66–14.50%)       |
| >100 kg (vs. <100 kg)         | 5.48%* (3.03–9.71%)       | 10.87%* (5.81–19.43%)     | 6.83%* (2.78–15.85%)      | 34.42% (26.19–43.71%)     |
| >90 kg (vs. <90 kg)           | 19.86%* (13.47–28.29%)    | 27.59% (19.75–37.11%)     | 22.54% (14.56–33.18%)     | 61.90% (53.05–70.02%)     |
| Weight (pounds) when decision was made to initiate biologics | 171.96* (165.38–178.55)    | 179.77* (169.91–189.63)   | 168.48* (162.66–174.30)   | 213.71 (205.86–221.57)    |
| Body mass index (BMI)         | 25.65* (24.94–26.36)      | 26.91a (25.86–27.97)      | 26.06a (25.35–26.77)      | 30.86 (29.62–32.11)       |
| Underweight-Normal            | 34.92%* (27.65–42.96%)    | 26.47% (19.92–34.25%)     | 37.48% (30.06–45.54%)     | 16.15% (11.50–22.20%)     |
| Overweight                    | 35.79% (28.15–44.23%)     | 35.77% (27.76–44.67%)     | 28.81% (20.72–38.52%)     | 29.74% (20.41–41.13%)     |
| Obese                         | 7.26%* (4.81–10.81%)      | 13.78%* (8.70–21.14%)     | 13.53% (8.24–21.41%)      | 37.29% (28.65–46.83%)     |
| Missing BMI                   | 22.84% (16.70–30.40%)     | 25.10%* (19.34–31.90)     | 23.00% (16.55–31.04)      | 19.98% (14.41–27.02%)     |
| Ethnicity                     |                           |                           |                           |                           |
| White                         | 71.11% (62.55–78.39%)     | 81.79% (75.77–86.58%)     | 75.96% (66.40–83.48%)     | 76.69% (68.58–83.22%)     |
| Hispanic                      | 8.96% (4.93–15.75%)       | 9.53% (6.14–14.50%)       | 11.22% (5.92–20.22%)      | 10.76% (6.96–16.25%)      |
| African American/Black         | 8.53% (4.74–14.88%)       | 4.00% (2.04–7.71%)        | 5.08% (2.73–9.24%)        | 4.57% (2.21–9.19%)        |
| Asian or Pacific Islander     | 9.66%* (5.23–17.17%)      | 3.57% (1.95–6.43%)        | 4.21% (2.36–7.41%)        | 3.18% (1.87–5.35%)        |
| American Indian or Alaskan Native | 0.36% (0.09–1.42%)  | 0.18% (0.03–1.26%)        | 2.80% (0.47–15.09%)       | 0.51% (0.07–3.82%)        |
| Do not know                   | 0.95% (0.40–2.20%)        | 0.90%* (0.34–2.31%)       | 1.03% (0.51–2.05%)        | 4.87% (1.16–18.27%)       |

Groups of comparison include etanercept versus ustekinumab 90 mg, adalimumab versus ustekinumab 90 mg and ustekinumab 45 mg versus ustekinumab 90 mg. Significance tests are based on test of betas (not shown) and not on the adjusted means themselves (produced from the normal or binary logistic regression models). LCL = lower confidence limit; UCL = upper confidence limit.

*p<0.05 for the difference between the treatment group result and the ustekinumab 90 mg group.
Primary objective: patient characteristics across biologics

Patient-level (adjusted bivariate results)

Adjusted bivariate results showed that mean age was 48.9 years old for ETA users, 48.2 years old for ADA users, 47.8 years for UST 45 mg users and 48.3 years for UST 90 mg users (Table 1). A similar proportion of users were male across treatment groups: 60.5% for ETA users, 65.5% for ADA, 59.8% for UST 45 mg and 66.9% for UST 90 mg, respectively.

The adjusted bivariate results also demonstrated marked differences in patient body weight characteristics among UST 90 mg users compared with UST 45 mg, ADA and ETA users. Patients were at significantly higher odds of weighing >100 kg on UST 90 mg (adjusted mean = 34.4%) than on ADA (10.9%), ETA (5.5%) or UST 45 mg (6.8%), all p < 0.001. Weight was not known for 415 patients (20.7%). The percentage of obese patients was higher with UST 90 mg (37.3%) than with ETA (7.3%), ADA (13.8%) or UST 45 mg (13.5%), all p < 0.001.

Total number of comorbidities was higher with UST 90 mg (1.9) than with ETA (1.4) or UST 45 mg (1.4), both p < 0.001, but not significantly higher than with ADA (1.7) (Table 2). Patients had higher affected body surface area (BSA) covered prior to treatment with UST 90 mg (39.4%) than ADA (35.6%), ETA (34.2%) or UST 45 mg (33.3%), all p < 0.03 (Table 2). BSA was not known for 159 patients (8.0%). Patients were at higher odds of severe (‘very marked plaque elevation, scaling and/or erythema’) PsO prior to treatment with UST 90 mg (31.1%) than with ADA (20.5%), ETA (18.4%) or UST 45 mg (20.0%), all p < 0.04. Severity was not known for 78 patients (3.9%).

Patients were at higher odds of having used prior biologics with UST 90 mg (42.7%) than with ADA (18.3%), ETA (7.2%) and UST 45 mg (32.6%), all p < 0.01. Prior treatment was unknown for 41 patients (2.1%). Among 570 patients with known prior biologic experience (i.e. more than one type of prior biologic used), the mean was significantly higher with UST 90 mg (1.6) than with ADA (1.2) and ETA (1.2) (both p < 0.01) but not significantly higher than with UST 45 mg (1.4). A higher percentage of patients on UST 90 mg (16.9%) reported having difficulty paying out-of-pocket than patients on ETA (9.9%), p < 0.05 (Table 2).

Secondary objective: predictors of treatment choice

Adjusting for patient characteristics as described above, weight >100 kg was a significant, independent predictor of UST 90 mg use versus UST 45 mg (odds ratio [OR] = 3.8), ETA (OR = 6.1) and ADA (OR = 2.7), controlling for other variables, as was patient change in weight (OR = 3.2, 7.0 and 6.3, respectively). Prior experience with biologics predicted UST 90 mg use versus ETA (OR = 7.0 for 1 prior biologic and OR = 19.6 for 2+ biologics) and ADA (OR = 2.4 and OR = 5.0, respectively). Prior moderate to severe (vs. clear to mild) PsO predicted UST 90 mg use versus ETA (OR = 8.6). All p < 0.05 for above results (Table 3).

Convenient administration (OR = 3.5), ease of administration (OR = 5.1) better dosing schedule (OR = 5.2), and faster improvement in symptoms (OR = 3.3) were all significant reasons for choosing UST 90 mg versus ETA. Ease of administration (OR = 2.4) was also a predictor of choosing UST 90 mg versus ADA. ‘Would stop the progression of psoriatic arthritis’ was a predictor of choosing UST 90 mg versus UST 45 mg (OR = 2.0) or ETA (OR = 2.5). Ease of insurance approval, longer time on market and more experience with the current drug were significant predictors of choosing ETA (OR = 4.3, 83.9 and 6.4, respectively) or ADA (OR = 4.1, 23.7 and 4.9, respectively) over UST 90 mg. Not having difficulty paying out-of-pocket for prescription was a predictor of choosing ETA (OR = 3.7) over UST 90 mg. Unknown coverage for prescription was a predictor of choosing UST 90 mg versus 45 mg (OR = 2.9). Feet, toes and toenails, as locations affected prior to current treatment, was a predictor of UST 90 mg versus ADA use (OR = 2.5). All p < 0.05 for the above results (Table 3).

Discussion

Among PsO patients treated with biologics, UST 90 mg was associated with greater comorbidities than ETA or UST 45 mg. Even after adjusting for covariates, UST 90 mg use was associated with higher weight, greater baseline severity, and more experience with prior biologics than ADA, ETA and/or UST 45 mg. The greater comorbidities observed among UST 90 mg users may reflect concomitant conditions experienced by overweight or obese patients who are the intended recipients of treatment according to weight-based guidelines. Although speculative, this point is supported by the absence of comorbidity as a significant predictor independent of patient weight in the predictive models. While previous research has assessed whether patient characteristics are associated with disease outcomes (6) and with treatment preferences (6–8), the current study is novel in describing and comparing the demographic and health characteristics of patients taking several biologic agents using a sampling framework that aims to represent patients in the real world.

For patients (as reported by participating dermatologists), convenient administration, ease of administration, better dosing schedule and faster improvement in symptoms were all significant reasons for choosing UST 90 mg over ETA. However, ease of insurance approval, longer time on market and more experience with the current drug were significant reasons for choosing ADA or ETA over UST 90 mg. These results corroborate prior research which has found that process-related factors, such as treatment location and delivery method, as well as disease outcomes, are important factors for patients in choosing treatment (8–9). Notably, prior PsO treatment preference research has focused on nonbiologic treatments (7). The current study adds to the literature by describing patients among biologic agent treatment groups, which may be more relevant for clinical decision making. The adjustment for covariates in the predictive models also increases our understanding of potential drivers of treatment choice, as the significant predictors in these models reflect potential influences independent of the other measures (e.g. ease of administration remained a significant predictor of UST 90 mg vs. ADA and ETA, even after controlling for patients’ experience with the drug and other variables that may be related).

Additionally, physicians’ perceptions of the characteristics of each biologic were generally consistent with individual patient reasons (as reported by physicians) for choosing the particular biologic.

Strengths and limitations

One of the primary benefits of a physician chart review over, for example, patient-reported surveys or claims data, is that physicians are able to provide reliable information on patient characteristics (e.g. time since diagnosis, time since initiating treatment) for those on various treatments. Physician charts allowed us to access a fairly representative sample of patients (e.g. including patients who for various reasons would not choose to or be able to participate in an online survey), which is key for understanding patient characteristics associated with treatment use in the real world. Moreover, the internet-based format via which data were collected allowed for an expedient, cost-effective
Table 2. Patient health and treatment characteristics, comparing etanercept versus ustekinumab 90 mg, adalimumab versus ustekinumab 90 mg and ustekinumab 45 mg versus ustekinumab 90 mg treatment groups (weighted and accounting for physician effects).

| Variable                                         | Etanercept | Adalimumab | Ustekinumab 45 mg | Ustekinumab 90 mg |
|--------------------------------------------------|------------|------------|-------------------|------------------|
| Prior affected body surface area (BSA)            |            |            |                   |                  |
| Percent body covered by plaque psoriasis before starting current biologic |            |            |                   |                  |
| Body covered: unknown                             | 34.17%*    | 35.55*     | 33.32*            | 39.40%           |
| Percent body covered by plaque psoriasis before starting current biologic | 7.72%*     | 16.31%*    | 21.97%            | 21.47%           |
| Percent body covered by plaque psoriasis before starting current biologic | 0.43%      | 20.85%     | 13.02%            | 8.17%            |
| Percent body covered by plaque psoriasis before starting current biologic | 11.20%     | 31.22%     | 13.27%            | 12.51%           |
| Percent body covered by plaque psoriasis before starting current biologic | 31.82%     | 31.22%     | 31.22%            | 31.22%           |
| Number of comorbidities                          |            |            |                   |                  |
| Mean number of comorbidities (including obesity) | 1.42%      | 37.40%*    | 24.07%            | 8.25%            |
| 0 comorbidities                                  | 1.42%      | 37.40%*    | 24.07%            | 8.25%            |
| 1 comorbidity                                    | 25.76%     | 25.76%     | 25.76%            | 25.76%           |
| 2 comorbidities                                  | 12.85%*    | 35.99%     | 35.99%            | 35.99%           |
| 3+ comorbidities                                 | 24.07%     | 35.02%     | 35.02%            | 35.02%           |
| Prior treatment                                  |            |            |                   |                  |
| Prescription topical steroids (creams, ointments, lotions, shampoos, gels, sprays, foam, solutions, etc.) | 89.49%     | 89.49%     | 89.49%            | 89.49%           |
| Nonsteroidal prescription topical treatments      | 46.70%     | 46.70%     | 46.70%            | 46.70%           |
| Light/phototherapy (UVB, narrow band UVB, PUVA, laser) | 35.99%     | 35.99%     | 35.99%            | 35.99%           |
| Prescription oral medications                    | 35.02%     | 35.02%     | 35.02%            | 35.02%           |
| Alefacept                                        | 0.28%*     | 0.28%*     | 0.28%*            | 0.28%*           |
| Etanercept                                       |            |            |                   |                  |
| Adalimumab                                       | 2.42%*     | 1.67%*     | 0.27%*            | 0.09%            |
| Efalizumab                                       | 1.67%*     | 1.67%*     | 0.27%*            | 0.09%            |
| Infliximab                                       | 0.27%*     | 0.27%*     | 0.27%*            | 0.09%            |
| Ustekinumab – 45 mg                              | 2.92%*     | 2.92%*     | 2.92%*            | 2.92%*           |
| Ustekinumab – 90 mg                              | 0.09%      | 0.09%      | 0.09%             | 0.09%            |
| Any over-the-counter (OTC), non-prescription products | 20.74%     | 20.74%     | 20.74%            | 20.74%           |
| Any other treatment                              | 0.25%      | 0.25%      | 0.25%             | 0.25%            |
| Never used any type of treatment for psoriasis prior to current therapy | 3.28%*     | 3.28%*     | 3.28%*            | 3.28%*           |
| Do not know                                      | 7.96%      | 7.96%      | 7.96%             | 7.96%            |
| Difficulty paying out of pocket                   | 9.85%      | 6.70%*     | 6.70%*            | 6.70%*           |
| Yes                                              | 8.60%      | 59.88%     | 59.88%            | 59.88%           |
| No                                               | 22.14%     | 22.14%     | 22.14%            | 22.14%           |

Groups of comparison include etanercept versus ustekinumab 90 mg, adalimumab versus ustekinumab 90 mg, and ustekinumab 45 mg versus ustekinumab 90 mg. Significance tests are based on test of betas (not shown) and not on the adjusted means themselves (produced from the normal or binary logistic regression models). LCL = lower confidence limit; PUVA = psoralen plus ultraviolet A; UCL = upper confidence limit; UVB = ultraviolet B.

*p < 0.05 for the difference between the treatment group result and the ustekinumab 90 mg group.
The current study revealed that physicians reported prescribing ADA and ETA to a higher proportion of their patients than UST (over twice as many). These results both highlighted the imbalance in prescriptions and therefore the need to oversample UST versus other biologics in the current study, plus they were used to generate the inverse proportional weights for analysis, thereby increasing the precision of within-group descriptive statistics and between-group comparisons.

Potential biases with patient charts include the following: (1) selection biases (e.g. physicians preferentially select charts for patients who are doing well on treatment); (2) physician selection (e.g. physicians may be selected who have preferences for one

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**Table 3. Potential predictors of UST 90 mg versus UST 45 mg, ETA or ADA.**

| Covariate                                      | UST 90 mg versus UST 45 mg | UST 90 mg versus ETA | UST 90 mg versus ADA |
|------------------------------------------------|-----------------------------|----------------------|----------------------|
|                                                 | OR  | LCL  | UCL  | OR  | LCL  | UCL  | OR  | LCL  | UCL  |
| Intercepta,b                                     | 0.10| 0.01 | 0.76 | 0.05| 0.01 | 0.48 | 0.14| 0.02 | 1.11 |
| Patient weight >100kgabc                         | 6.08| 2.25 | 16.46| 6.18| 2.68 | 14.25| 2.92| 1.29 | 6.59 |
| Weight not knownc                               | 0.74| 0.43 | 1.27 | 0.48| 0.22 | 1.06 | 0.42| 0.23 | 0.77 |
| Reference ≤ 100 kg                               | 0.95| 0.87 | 1.05 | 1.04| 0.93 | 1.16 | 1.10| 0.99 | 1.22 |
| Frequency of consultation in last 12 months      |     |      |      |     |      |      |     |      |      |
| Any additional prior biologic experience: Amevive, Embrel, Humira, Raptiva, Remicade or Stelara 45/90 mg Only 1 prior biologic abc | 1.35| 0.86 | 2.13 | 7.32| 2.75 | 19.54| 2.91| 1.66 | 5.11 |
| Additional prior biologic experience abc         | 1.14| 0.47 | 2.73 | 20.57| 7.18 | 58.94| 6.57| 2.48 | 17.43 |
| Reference = No prior biologic experience         |     |      |      |     |      |      |     |      |      |
| Severity of plaque psoriasis before starting current biologic |     |      |      |     |      |      |     |      |      |
| Mild to moderate                                  | 0.86| 0.15 | 4.80 | 5.20| 0.74 | 36.26| 3.24| 0.34 | 30.58 |
| Moderate                                         | 1.81| 0.34 | 9.57 | 2.25| 0.32 | 15.79| 2.46| 0.41 | 14.84 |
| Moderate to severe abc                           | 2.97| 0.52 | 17.05| 9.10| 1.36 | 61.03| 3.38| 0.59 | 19.52 |
| Severe                                           | 2.70| 0.51 | 14.33| 2.89| 0.43 | 19.62| 3.50| 0.60 | 20.52 |
| Don’t know severity                              | 0.79| 0.06 | 10.45| 2.56| 0.28 | 23.08| 2.08| 0.26 | 16.65 |
| Reference = Clear, almost clear or mild          |     |      |      |     |      |      |     |      |      |
| Reasons for choosing current biologic versus other biologics |     |      |      |     |      |      |     |      |      |
| Is safer to use long term                        | 0.68| 0.26 | 1.78 | 1.18| 0.49 | 2.86 | 0.93| 0.27 | 3.25 |
| Has been on the market for longer abc            | 0.25| 0.06 | 1.12 | 0.01| 0.00 | 0.06 | 0.02| 0.00 | 0.15 |
| Administration is more convenient abc            | 0.73| 0.46 | 1.15 | 3.46| 1.44 | 8.28 | 1.34| 0.66 | 2.69 |
| Has a better dosing schedule for this patient abc| 0.70| 0.45 | 1.09 | 5.41| 2.69 | 10.87| 1.67| 0.94 | 2.97 |
| Easier to get insurance approval for this product for this patient | 1.16| 0.49 | 2.73 | 0.23| 0.10 | 0.53 | 0.22| 0.09 | 0.54 |
| See a significant improvement in symptoms faster than other biologic options abc | 1.20| 0.74 | 1.96 | 3.34| 1.58 | 7.06 | 0.97| 0.49 | 1.95 |
| Would stop the progression of psoriatic arthritis abc | 3.07| 1.59 | 5.92 | 2.56| 1.33 | 4.95 | 1.21| 0.53 | 2.78 |
| Is easier to administer abc                       | 1.56| 0.90 | 2.69 | 5.20| 1.97 | 13.74| 2.73| 1.05 | 7.07 |
| Manufacturer has a better reputation than the others abc | 0.95| 0.24 | 3.78 | 0.09| 0.01 | 0.73 | 0.45| 0.15 | 1.38 |
| I have had more experience with this current drug than with other similar biologics abc | 0.40| 0.14 | 1.16 | 0.16| 0.05 | 0.46 | 0.18| 0.07 | 0.47 |
| Patient’s weight changed (up or down) abc        | 6.74| 2.27 | 19.98| 7.34| 1.28 | 42.06| 6.43| 1.62 | 25.49 |
| Reference = Not selected                         |     |      |      |     |      |      |     |      |      |
| Body locations covered by plaque psoriasis prior to current biologic |     |      |      |     |      |      |     |      |      |
| Feet, toes and toenails abc                      | 1.19| 0.73 | 1.94 | 1.25| 0.66 | 2.35 | 2.72| 1.56 | 4.75 |
| Reference = Not selected                         |     |      |      |     |      |      |     |      |      |
| Employment status                                | 1.67| 0.90 | 3.10 | 0.54| 0.29 | 1.03 | 1.16| 0.62 | 2.14 |
| Reference = Unemployed/homemaker/retired/disabled or unknown |     |      |      |     |      |      |     |      |      |
| Insurance coverage for prescription              |     |      |      |     |      |      |     |      |      |
| Yes, treatment covered                          | 2.68| 0.89 | 8.03 | 1.49| 0.27 | 8.29 | 0.38| 0.12 | 1.24 |
| Coverage unknown abc                             | 3.93| 1.04 | 14.88| 3.05| 0.43 | 21.60| 0.29| 0.06 | 1.47 |
| Reference = No/no insurance                     |     |      |      |     |      |      |     |      |      |
| Difficulty paying out-of-pocket costs for biologic prescription |     |      |      |     |      |      |     |      |      |
| Yes abc                                         | 0.93| 0.38 | 2.30 | 0.27| 0.11 | 0.64 | 0.53| 0.23 | 1.21 |
| Do not know abc                                  | 0.69| 0.23 | 2.08 | 0.58| 0.19 | 1.82 | 0.76| 0.29 | 2.00 |

Presented are odds ratios (ORs) and 95% lower (LCL) and upper (UCL) confidence limits from each of three GEE models predicting ustekinumab (UST) 90 mg versus UST 45 mg, etanercept (ETA) or adalimumab (ADA).

*p<0.05 for UST 90 mg versus UST 45 mg.

*p<0.05 for UST 90 mg versus ETA.

*p<0.05 for UST 90 mg versus ADA.
type of therapy over another); and (3) missing information on patient characteristics of interest (e.g., no data on patient education level or income, etc.). Participating dermatologists came from a panel of physicians largely representative of dermatologists in the United States, allowing for a variety of physician preferences and their corresponding patients. Patient chart selection biases were minimized via instructions to physicians (e.g., requests for pulling a randomly chosen qualifying chart for each treatment type). Certain characteristics were missing for many patients or on a physician-by-physician basis. This limitation is inherent in the design, but we made sure to capture as many related variables as possible to minimize this bias as well.

Other limitations of this study include that the data were reported by physicians, retrospectively and for a very small sample of each physician’s patients \( (n = 5) \). All effort was taken to avoid potential bias from this design, but it is impossible to exclude all sources of bias that could be introduced via this type of design. It is possible that the retrospective recall by physicians led to imprecise estimates of the reasons for prescribing different biologics by physicians. It is also difficult for us to control (beyond giving specific instructions) the specific charts that physicians pulled. However, in none of these cases, did we expect systematic bias on the part of the physician. In terms of missing information on patient characteristics of interest, a total of 414 patients had missing weight information. Additionally, there may be inaccurate recordings of patients’ weight by physicians. The weight cutoff guidelines for UST 90 mg administration is technically 220 lbs.; however, an examination of the distribution of patients’ weights revealed several modal responses, including a notable one at 200 lbs., suggesting that the likely cutoff for UST administration was in practice 200 lbs. However, it may also be the case that physicians were estimating patients’ weights and used 200 lbs. as a convenient “round number,” when in fact those patients were 220 lbs. or heavier.

Conclusions

This study reveals patient characteristics associated with dermatologists’ prescribing behavior for biologics in PsO and potential drivers of treatment, which can help inform access and reimbursement decisions. In particular, patients with plaque PsO using UST 90 mg are on average different from those using ADA, ETA and UST 45 mg with respect to weight, prior severity and prior biologics experience. Future prospective studies are warranted to provide support for and replication of these findings.

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Declaration of interest

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Supplementary material available online
Supplementary material appendix