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# Examining Treatment Decision-Making Among Patients With Axial Spondyloarthritis: Insights From a Conjoint Analysis Survey

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**Objective.** The number of therapies for axial spondyloarthritis (axSpA) is increasing. Thus, it has become more challenging for patients and physicians to navigate the risk-benefit profiles of the various treatment options. In this study, we used conjoint analysis—a form of trade-off analysis that elucidates how people make complex decisions by balancing competing factors—to examine patient decision-making surrounding medication options for axSpA.

**Methods.** We conducted an adaptive choice-based conjoint analysis survey for patients with axSpA to assess the relative importance of medication attributes (eg, chance of symptom improvement, risk of side effects, route of administration, etc) in their decision-making. We also performed logistic regression to explore whether patient demographics and disease characteristics predicted decision-making.

**Results.** Overall, 397 patients with axSpA completed the conjoint analysis survey. Patients prioritized medication efficacy (importance score 26.8%), cost (26.3%), and route of administration (13.9%) as most important in their decision-making. These were followed by risk of lymphoma (9.5%), dosing frequency (7.2%), risk of serious infection (6.0%), tolerability of side effects (5.3%), and clinic visit and laboratory test frequency (4.8%). In regression analyses, there were few significant associations between patients' treatment preferences and sociodemographic and axSpA characteristics.

**Conclusions.** Treatment decision-making in axSpA is highly individualized, and demographics and baseline disease characteristics are poor predictors of individual preferences. This calls for the development of online shared decision-making tools for patients and providers, with the goal of selecting a treatment that is consistent with patients' preferences.

## INTRODUCTION

Axial spondyloarthritis (axSpA) is a chronic, progressive form of inflammatory arthritis affecting the axial skeleton and includes both nonradiographic axSpA and ankylosing spondylitis (AS) (radi-

ographic form of axSpA) (1,2). There are numerous treatments for axSpA, ranging from nonsteroidal anti-inflammatory drugs (NSAIDs) to biologics (3-7), and it can be difficult for patients to navigate the array of options and choose a therapy that aligns with their preferences. Adding to this complexity is that even

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Drs. Joo and Almario contributed equally to this work.

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within medication classes, particularly for biologics, there are varying mechanisms of action, modes of administration, effectiveness, and side effects.

We thus sought to understand how patients with axSpA decide from among the different treatment options by using conjoint analysis—a technique that determines how people make complex decisions by balancing competing factors. Conjoint analysis is based on the idea that any product (eg, a service, test, or treatment) can be described by its attributes and is valued based on the levels of these attributes. It is administered via a computer-based interactive exercise in which respondents evaluate competing profiles (eg, of axSpA treatments) and select their preferred profile (see example in Figure 1). In this study, we specifically aimed to quantify and rank-order the relative importance of axSpA medication attributes (eg, efficacy, side effects, route of administration, cost, etc) in patients' decision-making, without making reference to any generic or branded products. Furthermore, we evaluated whether certain patient factors (ie, sociodemographic and axSpA characteristics) predicted preference patterns.

## PATIENTS AND METHODS

### Overview of conjoint analysis

Conjoint analysis is a method that quantifies how respondents make trade-offs when considering competing factors (8).

This approach assumes that decision-making is based on the attributes of a product, each of which has multiple levels. A series of side-by-side profiles of unbranded hypothetical products are presented, with each profile having unique levels assigned to each attribute (Figure 1). Based on the respondent's answer to the first comparison, an algorithm selects a new side-by-side comparison and asks the respondent to select the preferred profile. Conjoint analysis is used extensively in clinical research (8), and examples extend across diverse domains, including rheumatology (9-11), spinal surgery (12), diabetes management (13), and inflammatory bowel disease (IBD) (14).

### Adaptive choice-based conjoint analysis for therapy decision-making in axSpA

We employed adaptive choice-based conjoint (ACBC) analysis software (Sawtooth Software) to determine how patients with axSpA make decisions when selecting from among the various treatment options. Table 1 displays the eight attributes and their associated levels that were tested in the ACBC analysis survey; these were based on characteristics of axSpA therapies, including NSAIDs and biologics. The eight attributes were further organized in four categories: 1) medication characteristics (route of administration, dosing frequency, frequency of clinic appointments, and laboratory testing), 2) efficacy (ie, chance of improvement in axSpA symptoms), 3) side effect profile

	Medicine A	Medicine B	Medicine C
<b>Way You Receive The Medicine</b>	Medicine self-injected under the skin at home	Medicine given through IV into the vein at home	Medicine self-injected under the skin at home
<b>How Often You Take The Medicine</b>	Medicine taken every 4 weeks	Medicine taken every 6 weeks	Medicine taken every 2 weeks
<b>Chance Of Improvement In Your AS Symptoms</b>	35% chance your AS symptoms will improve	35% chance your AS symptoms will improve	65% chance your AS symptoms will improve
<b>Chance That You Stop Taking The Medicine Because Of Side Effects</b>	3% chance of stopping the medicine due to side effects	5% chance of stopping the medicine due to side effects	5% chance of stopping the medicine due to side effects
<b>Risk Of Lymphoma (Blood Cancer)</b>	6 out of 10,000 risk of lymphoma	2 out of 10,000 risk of lymphoma	4 out of 10,000 risk of lymphoma
<b>Risk Of A Serious Infection</b>	1% risk of serious infection	5% risk of serious infection	1% risk of serious infection
<b>Out Of Pocket Cost Per Month</b>	Pay \$500 each month	Pay \$250 each month	Pay \$100 each month
<b>How Often You Visit The Clinic</b>	Clinic visit and lab tests every 6 months	Clinic visit and lab tests every 3 months	Clinic visit and lab tests every 12 months
	○	○	○

**Figure 1.** Sample choice tournament task in which participants consider three hypothetical medication profiles side by side and decide which medication they would prefer for treating their axial spondyloarthritis. Respondents were shown 20 different vignettes, each of which with varying attribute levels. Abbreviation: AS, ankylosing spondylitis; IV, intravenous.

**Table 1.** Medication attributes and levels included in the conjoint analysis survey

Attribute Category	Specific Attribute	Attribute Levels
Medication characteristics	Route of administration	<ul style="list-style-type: none"> <li>• Pill by mouth</li> <li>• Subcutaneous injections at home</li> <li>• Intravenous infusions in the clinic</li> <li>• Intravenous infusions at home</li> </ul>
	Dosing frequency	<ul style="list-style-type: none"> <li>• Every day</li> <li>• Every week</li> <li>• Every 2 wk</li> <li>• Every 4 wk</li> <li>• Every 6 wk</li> </ul>
	Frequency of clinic appointments and laboratory tests	<ul style="list-style-type: none"> <li>• Every 3 mo</li> <li>• Every 6 mo</li> <li>• Every 12 mo</li> </ul>
Efficacy	Chance of improvement in AS symptoms	<ul style="list-style-type: none"> <li>• 20%</li> <li>• 35%</li> <li>• 50%</li> <li>• 65%</li> </ul>
Side effect profile	Tolerability of unwanted side effects (ie, chance of stopping the medication because of side effects)	<ul style="list-style-type: none"> <li>• 1%</li> <li>• 3%</li> <li>• 5%</li> </ul>
	Risk of lymphoma <sup>a</sup>	<ul style="list-style-type: none"> <li>• 2 of 10 000</li> <li>• 4 of 10 000</li> <li>• 6 of 10 000</li> </ul>
	Risk of serious infection	<ul style="list-style-type: none"> <li>• 1%</li> <li>• 3%</li> <li>• 5%</li> </ul>
Cost	Out-of-pocket costs per month	<ul style="list-style-type: none"> <li>• \$50</li> <li>• \$100</li> <li>• \$250</li> <li>• \$500</li> </ul>

Abbreviation: AS, ankylosing spondylitis.

<sup>a</sup> Respondents were informed that the baseline risk of lymphoma without biologics is 2 of 10 000.

(tolerability of unwanted side effects or reactions, risk of lymphoma, and risk of serious infection), and 4) out-of-pocket costs per month. These attributes were selected based on input from the literature (10,15-18); our axSpA social media netnography research, which examined patient concerns and perceptions regarding biologics (19); axSpA content experts on the research team; and on US Food and Drug Administration labels (including “black box warnings”) for currently marketed products to ensure accurate representation of factors important in the decision-making process.

The ACBC analysis software uses the inputted attributes and levels to create a series of side-by-side profiles of hypothetical axSpA therapies as part of a “choice tournament” with 20 distinct decisions (Figure 1). After participants complete the survey, the software uses hierarchical Bayes regression to estimate individual-level utility coefficients (20,21). These coefficients—called part-worth utilities—are generated for each attribute level, and levels with greater importance in the decision-making process have higher part-worth utilities. The ACBC analysis software also generates importance scores, which are derived by calculating the  $\Delta$  between the part-worth utilities for the most important and least important levels of each attribute (21). A larger  $\Delta$  in part-worth utilities correlates with a larger importance of the attribute in the decision-making process. More information about ACBC analysis, part-worth utilities, and importance scores (14) can be found at the following link: <http://links.lww.com/AJG/A215>.

## Survey design

Prior to the full launch of the survey, the entire instrument was pilot tested with five patients with axSpA to ensure understandability and usability. Once respondents accessed the survey, we first assessed their eligibility (see Participants section for details). Eligible participants then proceeded through the choice tournament exercise as described earlier. Before seeing the first set of side-by-side profiles, participants were shown descriptions of the medication attributes used in the survey to facilitate their understanding of each characteristic (Supplementary Figure 1). This information was also available during the choice tournament exercise when participants hovered their cursor over the attribute labels.

After the conjoint vignettes, the survey presented questions regarding sociodemographic information (eg, age, sex, insurance, etc) and axSpA characteristics, including time since axSpA symptoms started, symptom severity within the past week as measured by the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) (22), and current and prior axSpA treatments. These data were collected to explore potential correlations between patient factors and therapy preferences. This study was approved at all sites using the Streamlined, Multisite, Accelerated Resources for Trials Institutional Review Board (SMART IRB) Reliance platform, with the Cedars-Sinai Institutional Review Board serving as the main site (Pro50046).

## Participants

Participants aged 18 years and older with axSpA were recruited to complete the online survey between March 14, 2018, and June 21, 2019. We recruited patients with axSpA receiving care at Cedars-Sinai Medical Center, University of Massachusetts (UMass) Memorial Medical Center, and University of California, San Francisco (UCSF) Medical Center. We also partnered with the Spondylitis Association of America (SAA), who included the

survey invitation in their June 2018 eSUN newsletter to more than 25000 recipients as well as posted the survey link on their website's "Participate in Spondylitis Research" page. No honorarium was awarded to respondents from the above panels for completing the survey. Participants also needed to confirm that they had axSpA by answering "yes" to the question "Have you been diagnosed with AS by a physician?" Although we asked about AS diagnosis in the survey, we use the axSpA umbrella term throughout this article because we did not have access to radiographs

**Table 2.** Study population demographics

Variable	All Respondents (N = 397)	Patients With Medically Confirmed axSpA <sup>a</sup> (n = 122)
Age, mean (SD), y	44.4 (15.7)	51.1 (14.3)
Male sex, %	49.4	68.0
Race/ethnicity, %		
Non-Hispanic white	78.8	70.5
Non-Hispanic black, Latino, non-Hispanic Asian, or other	21.2	29.5
Education, %		
High school or less	10.8	5.7
Some college	19.9	12.3
College degree	34.3	35.3
Graduate degree	35.0	46.7
Married or long-term relationship, %	74.3	68.9
Employed or full-time student, %	68.3	69.7
Total household income, %		
≤\$50 000	22.2	12.3
\$50 001-\$100 000	24.9	17.2
\$100 001-\$200 000	31.0	27.1
≥\$200 001	14.1	29.5
Prefer not to say	7.8	13.9
Has insurance, %	97.5	100.0
Physical activity vs. others, %		
Much less active	14.1	3.3
Less active	19.9	14.8
Similar	27.0	30.3
More active	23.9	32.0
Much more active	15.1	19.7
Duration of axSpA symptoms, mean (SD), y	16.4 (14.6)	26.6 (14.5)
BASDAI score, <sup>b</sup> mean (SD)	4.7 (2.3)	3.4 (2.3)
Nonbiologic medication use, %		
Nonselective NSAID	47.6	36.9
COX-2 inhibitor (celecoxib)	19.1	9.0
Methotrexate	18.6	5.7
Leflunomide	12.1	0.8
Sulfasalazine	14.6	4.9
Glucocorticoids	18.6	5.7
Other	12.9	11.5
Biologic medication exposure, %		
Biologic naïve	30.0	21.3
Prior use of biologics	11.1	10.7
Currently using biologics	58.9	68.0
Recruitment source, %		
Cedars-Sinai Medical Center	15.1	49.2
UMass Memorial Medical Center	3.0	9.8
UCSF Medical Center	12.6	41.0
Spondylitis Association of America	27.5	...
Cint (survey research firm)	41.8	...

Abbreviation: axSpA, axial spondyloarthritis; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; NSAID, nonsteroidal anti-inflammatory drug; UCSF, University of California, San Francisco; UMass, University of Massachusetts.

<sup>a</sup> Patients receiving care at Cedars-Sinai Medical Center, UMass Memorial Medical Center, or UCSF Medical Center.

<sup>b</sup> Higher BASDAI score corresponds to more severe symptoms.

from those recruited through the SAA or Cint (see details below) for distinguishing between AS and nonradiographic axSpA.

We also recruited patients in partnership with Cint, a US survey research firm. Because users who complete studies through Cint were provided an honorarium, the Cint version of the survey included a blinded screening question. Respondents were asked if they had been diagnosed with any of the following conditions (presented in random order) by a physician: AS, juvenile idiopathic arthritis, lupus, osteoarthritis, polymyalgia rheumatica, rheumatoid arthritis, or none of the above. Only those who stated that they were diagnosed with AS were allowed to proceed. By using a screener with six rheumatologic conditions, we hoped to maximize the likelihood that respondents had been diagnosed with axSpA and were not simply seeking compensation by participating in a survey. Of note, we performed sensitivity analyses with and without the SAA and Cint cohorts to confirm lack of systematic differences between self-reported (ie, those from SAA and Cint) and medically confirmed axSpA (ie, patients from Cedars-Sinai, UMass, and UCSF medical centers).

### Statistical analyses

Based on conjoint analysis sample size precedents and recommendations from the software provider (23), we aimed to recruit at least 300 patients with axSpA to complete the conjoint

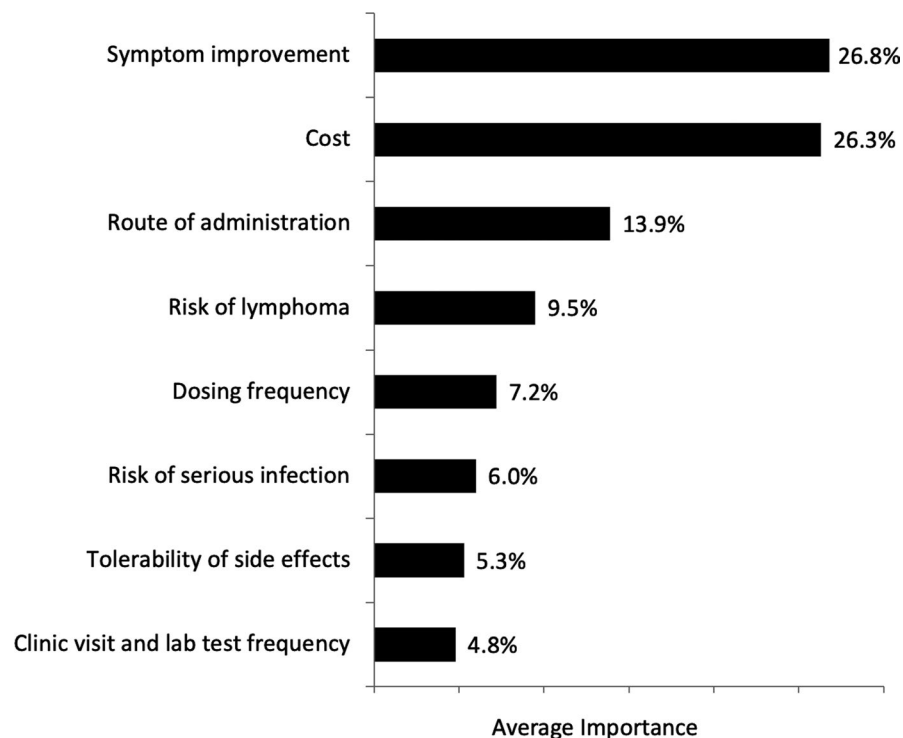
analysis survey. Statistical analyses were performed using Stata 13.1 (StataCorp LP). A two-tailed *P* value of less than 0.05 was considered significant. Descriptive analyses were used for patient sociodemographic and disease characteristics, importance scores, and patient-level preferences report ratings.

We used multivariable logistic regression models to adjust for potentially confounding factors and to calculate odds ratios and 95% confidence intervals (CIs). The outcomes in the models were whether individuals reported the following attribute categories as the most important factor in their decision-making: 1) medication characteristics (route of administration, dosing frequency, frequency of clinic appointments), 2) efficacy, 3) side effect profile (tolerability of unwanted side effects or reactions, risk of lymphoma, risk of serious infection), and 4) cost. The regressions included patient-level sociodemographic variables and axSpA clinical variables as covariates.

## RESULTS

### Study population

Supplementary Figure 2 displays the flow diagram of enrolled patients, stratified by recruitment source. Demographic and disease characteristics of the 397 patients with axSpA included in the final analysis are presented in Table 2.



**Figure 2.** Average attribute importance scores for patients with axial spondyloarthritis (N = 397). The mean importance of each medication attribute is based on part-worth utilities. Chance of symptom improvement, cost, and route of administration were the most important factors and accounted for 26.8%, 26.3%, and 13.9% of decision-making, respectively.



## Overall rank-ordering of medication attribute importance

The average importance scores calculated and ranked by the ACBC analysis algorithm are shown in Figure 2. On average, patients prioritized medication efficacy, cost, and route of administration as the three most important factors when selecting from among the various options. These were followed by risk of lymphoma, dosing frequency, risk of serious infection, tolerability of side effects, and clinic visit and laboratory test frequency.

When grouping the eight attributes into four overarching categories, 177 (44.6%) respondents reported efficacy to be the most important factor when choosing from among the options. One hundred fifty-two (38.3%) and 56 (14.1%) participants reported cost and medication characteristics (route of administration, dosing frequency, clinic visit and laboratory test frequency), respectively, as the predominant factor. Conversely, only 12 (3.0%) prioritized side effect profile (tolerability of unwanted side effects or reactions, risk of lymphoma, risk of serious infection) in their decision-making.

## Route of administration: oral versus subcutaneous versus intravenous

In the part-worth utilities assessment, we found that 198 (49.9%) participants preferred an oral axSpA medication. The

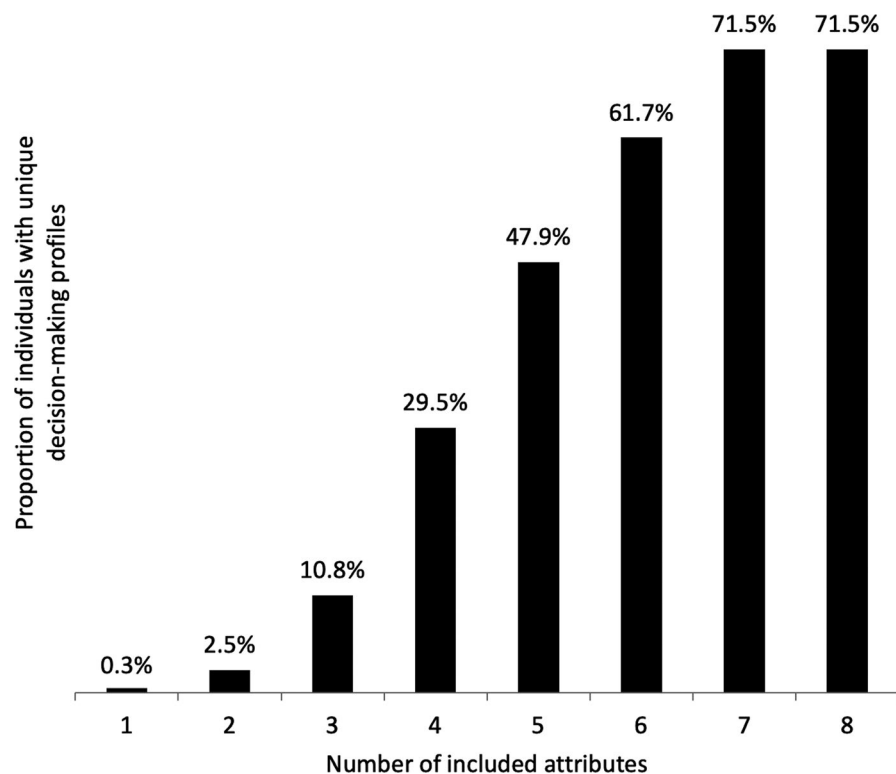
remaining respondents desired a parenterally delivered medication. One hundred twenty-eight (32.2%) participants preferred subcutaneous administration, whereas 71 (17.9%) participants selected an intravenous-infused medication.

## Uniqueness of individual preferences report

The conjoint software rank-ordered the relative importance scores of all eight medication attributes for each respondent, which, taken together, represents an individual preferences report. For example, a participant may have the following medication attribute rank order: 1) cost, 2) efficacy, 3) route of administration...8) risk of serious infection. When comparing the reports among participants, we found a high level of uniqueness. Figure 3 shows the proportion of unique decision-making profiles stratified by the number of included attributes. When evaluating the rank order of all eight attributes, nearly three-quarters of respondents had a ranking that did not match that of anyone else. Even when limiting the analysis to only four attributes, approximately one-third of participants still had a unique report.

## Predictors of therapy decision-making

Results from the multivariable regressions assessing independent predictors of patient preferences are listed in Table 3.



**Figure 3.** Proportion of unique decision-making profiles stratified by number of included attributes (N = 397). For each respondent, the conjoint software rank-ordered the importance of the eight medication attributes as he or she selected among the various options. When considering individuals' top three attributes, only 10.8% of respondents had a unique decision-making profile (ie, rank-ordering of top three attributes did not match anyone else's). However, when including all eight medication attributes, 71.5% had unique profiles.

**Table 3.** ORs for reporting medication efficacy, cost, or characteristics as the most important factor in the decision-making process (N = 397)<sup>a</sup>

Variable	Most Important Medication Attribute					
	Efficacy		Cost		Medication Characteristics <sup>b</sup>	
	n (%) <sup>c</sup>	OR (95% CI) <sup>d</sup>	n (%) <sup>c</sup>	OR (95% CI) <sup>d</sup>	n (%) <sup>c</sup>	OR (95% CI) <sup>d</sup>
Age, y	...	0.99 (0.97-1.01)	...	1.02 (0.99-1.04)	...	0.99 (0.96-1.02)
Sex						
Male	90 (45.9)	Reference	71 (36.2)	Reference	32 (16.3)	Reference
Female	87 (43.3)	1.11 (0.70-1.75)	81 (40.3)	0.99 (0.62-1.56)	24 (11.9)	0.66 (0.35-1.25)
Race/ethnicity						
Non-Hispanic white	136 (43.5)	Reference	130 (41.5)	Reference	37 (11.8)	Reference
Non-Hispanic black, Latino, non-Hispanic Asian, or other	41 (48.8)	1.12 (0.63-1.97)	22 (26.2)	0.58 (0.32-1.06)	19 (22.6)	1.96 (0.96-4.00)
Education						
High school or less	16 (37.2)	Reference	17 (39.5)	Reference	9 (20.9)	Reference
Some college	34 (43.0)	1.13 (0.49-2.56)	32 (40.5)	1.05 (0.46-2.39)	11 (13.9)	0.75 (0.26-2.16)
College degree	53 (39.0)	0.78 (0.35-1.73)	63 (46.3)	1.66 (0.75-3.66)	16 (11.8)	0.59 (0.21-1.61)
Graduate degree	74 (53.2)	1.11 (0.49-2.52)	40 (28.8)	0.90 (0.39-2.08)	20 (14.4)	0.84 (0.29-2.37)
Relationship status						
Married or long-term relationship	130 (44.1)	Reference	113 (38.3)	Reference	44 (14.9)	Reference
Not married	47 (46.1)	1.26 (0.73-2.20)	39 (38.2)	0.85 (0.48-1.51)	12 (11.8)	0.81 (0.37-1.80)
Employment status						
Unemployed	56 (44.4)	Reference	48 (38.1)	Reference	18 (14.3)	Reference
Employed or student	121 (44.7)	0.83 (0.47-1.47)	104 (38.4)	1.56 (0.86-2.82)	38 (14.0)	0.59 (0.26-1.32)
Total household income						
≤\$50 000	33 (37.5)	Reference	41 (46.6)	reference	13 (14.8)	Reference
\$50 001-\$100 000	37 (37.4)	0.95 (0.48-1.88)	45 (45.5)	1.03 (0.52-2.02)	13 (13.1)	0.73 (0.28-1.89)
\$100 001-\$200 000	43 (35.0)	0.97 (0.47-1.99)	51 (41.5)	0.75 (0.36-1.55)	25 (20.3)	1.28 (0.49-3.33)
≥\$200 001	44 (78.6)	6.38 (2.51-16.22)	10 (17.9)	0.27 (0.10-0.71)	2 (3.6)	0.14 (0.03-0.76)
Prefer not to say	20 (64.5)	2.72 (1.08-6.87)	5 (16.1)	0.26 (0.09-0.80)	3 (9.7)	0.45 (0.11-1.94)
Physical activity vs. others						
Much less active	15 (26.8)	Reference	34 (60.7)	Reference	4 (7.1)	Reference
Less active	33 (41.8)	2.15 (0.95-4.88)	30 (38.0)	0.39 (0.18-0.84)	11 (13.9)	1.81 (0.51-6.49)
Similar	53 (49.5)	2.70 (1.22-5.96)	38 (35.5)	0.38 (0.18-0.80)	15 (14.0)	2.11 (0.61-7.25)
More active	50 (52.6)	2.39 (1.04-5.52)	30 (31.6)	0.40 (0.18-0.89)	14 (14.7)	2.45 (0.68-8.78)
Much more active	26 (43.3)	1.47 (0.59-3.62)	20 (33.3)	0.51 (0.22-1.21)	12 (20.0)	3.37 (0.89-12.79)
Duration of axSpA symptoms, y	...	1.030 (1.009-1.052)	...	0.978 (0.957-0.999)	...	0.988 (0.958-1.018)
BASDAI score	...	0.99 (0.88-1.10)	...	1.07 (0.95-1.20)	...	0.94 (0.81-1.10)
Biologic medication use						
Biologic naïve	46 (38.7)	Reference	51 (42.9)	Reference	17 (14.3)	Reference
Prior use of biologics	17 (38.7)	1.04 (0.48-2.27)	22 (50.0)	1.34 (0.62-2.89)	5 (11.4)	0.73 (0.23-2.32)
Currently using biologics	114 (48.7)	1.49 (0.87-2.56)	79 (33.8)	0.71 (0.41-1.23)	34 (14.5)	0.94 (0.44-1.97)

Abbreviation: axSpA, axial spondyloarthritis; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; CI, confidence interval; OR, odds ratio.

<sup>a</sup> We did not conduct a regression on reporting of the side effect profile as the most important factor in the decision-making process because only 12 individuals prioritized it in the study.

<sup>b</sup> Includes route of administration, dosing frequency, and clinic visit and laboratory test frequency.

<sup>c</sup> Represents the number of persons prioritizing the respective factor as the most important in their decision-making process.

<sup>d</sup> The multivariable logistic regression model included all covariates in the table. Insurance status was not included in the model because 97.5% of respondents had health insurance.

Overall, sociodemographic and clinical factors largely did not predict treatment preferences, save for a few exceptions. Individuals from high-income households (ie, greater than or equal to \$200 001 per year) had significantly higher odds of noting medication efficacy as the most important factor when selecting from among the options and were less likely to prioritize cost or medication characteristics. Increasing duration of axSpA symptoms was associated with increased odds for valuing medication efficacy. We also found that increasing levels of physical activity was inversely associated with the odds for prioritizing medication cost. Moreover, those who reported being more

or similarly active as compared with others had higher odds for prioritizing medication efficacy when compared with those who were much less active. The remaining variables largely were not predictive of decision-making.

### Subgroup analyses

We performed a subgroup analysis among the 122 patients with axSpA receiving care at Cedars-Sinai, UMass, or UCSF (Table 2). When compared against the primary analyses, the overall rank-ordering of medication attribute importance was similar:



symptom improvement, 32.3%; cost, 23.8%; route of administration, 14.9%; risk of lymphoma, 9.8%; risk of serious infection, 5.5%; dosing frequency, 5.3%; tolerability of unwanted side effects, 4.5%; clinic visit and laboratory test frequency, 3.9%. We also continued to see a high level of uniqueness with respect to respondents' preferences report; when considering their rankings of the eight attributes, we found that 90 (73.8%) participants had a report that did not match anyone else's.

When grouping the eight attributes into four overarching categories, we found that participants prioritized the following as the most important factor in their decision-making: efficacy (76 [62.3%]), cost (28 [23.0%]), medication characteristics (16 [13.1%]), and side effect profile (2 [1.6%]). Similar to the primary regression analyses, patient sociodemographic and axSpA characteristics largely were not predictive of decision-making (Supplementary Table 1). The one exception was income; those from households making greater than or equal to \$200,001 per year had 8.34 (95% CI 1.24-56.11) times the odds of prioritizing medication efficacy compared with those making less than or equal to \$50,000 per year.

## DISCUSSION

Using conjoint analysis, we found that on average, patients with axSpA prioritize medication efficacy, cost, and route of administration when selecting from among the various options. However, we also found that treatment decision-making is highly individualized; patient sociodemographic and axSpA clinical characteristics poorly predict medication preferences.

Our analysis is one of a small number of studies that have analyzed how patients with axSpA make decisions regarding potential therapies. Nolla et al (10) conducted a conjoint analysis assessing attribute preferences of biologics used in the treatment of rheumatologic diseases in Spain. Among patients with axSpA, the authors found that patients prioritize pain relief, followed by risk of adverse events (high vs. low risk), administration method, and, lastly, duration of effects. Conversely, our study—which also included costs and specific side effects and modeled both biologic and nonbiologic options—found that patients value symptom improvement the most, followed by cost, route of administration, and risk of lymphoma.

To our knowledge, our study is the first to assess the impact of medication out-of-pocket costs on decision-making in axSpA, which ranks second highest in importance among patients. Not surprisingly, household income influences how cost is factored into decision-making. Individuals reporting a household income of less than or equal to \$50,000 are more likely to prioritize cost compared with those from households making more than \$200,000. Of note, prior studies in rheumatoid arthritis have assessed the role of medication costs in decision-making (24,25). Augustovski et al (24) found that cost is the most important consideration in choosing a rheumatoid arthritis medication among Argentinians,

whereas Louder et al (25) noted that cost is the fourth most important of seven attributes in commercially insured Americans. Additional research examining how medication costs impact treatment decision-making, adherence, and outcomes in axSpA is warranted.

Our finding of the highly individualized nature of selecting an axSpA treatment is consistent with our prior study examining biologic decision-making among patients with IBD (14). However, when responses between the cohorts are considered, some differences are noted. Although the proportions of individuals with axSpA (45%) and IBD (41%) who reported efficacy as the most important factor in the decision-making process were similar, a higher percentage of patients with IBD (38%) prioritized avoidance of side effects compared with those with axSpA (3%) (14). This suggests that patients with axSpA may approach treatment decision-making differently from those with IBD. Of note, the conjoint analysis survey administered to those with IBD did not include cost, which was highly valued among individuals with axSpA. It is possible that the proportion of patients with IBD who prioritized avoidance of side effects would have decreased had cost been included as an attribute in the survey. Regardless, this calls for the need for further research to better understand how those with axSpA consider medication side effects when choosing a therapy.

In our analyses, when attempting to identify predictors of individual choices, we found that sociodemographic and axSpA clinical factors were rarely helpful in predicting medication preferences, except in a few cases. For example, we found that those with total household incomes greater than \$200,000 and patients with a longer duration of axSpA symptoms were more likely to prioritize efficacy when choosing from among the different treatment options. We also discovered that individuals who reported higher levels of physical activity as compared with others were less likely to note out-of-pocket cost as the most important factor. These patients may be willing to spend more money on axSpA therapies to maintain their active lifestyles. Interestingly, axSpA symptom severity, as measured by the BASDAI, is not associated with decision-making; worse symptoms do not predict prioritization of a medication's efficacy when choosing an axSpA therapy. Moreover, when considering each respondent's preferences report, we found that nearly three-quarters had a completely unique decision-making profile. These results emphasize that providers cannot rely on demographic or clinical variables to accurately predict which therapy will align with a patient's personal values.

Because of the highly individualized nature of decision-making in axSpA, along with health care's increased emphasis on shared decision-making between patients and providers (11,26,27), it is important for clinicians to identify what matters most to patients when choosing from among therapeutic options. Yet, in the context of a brief clinical visit, it can be challenging for rheumatologists to determine a patient's unique preferences profile while also engaging in detailed discussions around each treatment's risks, benefits, and trade-offs. Thus, there is a need for simple and efficient decision

tools that elicit individual preferences and support the patient-provider interaction. In IBD, we developed an online decision aid called IBD&me ([www.ibdandme.org](http://www.ibdandme.org)) that uses conjoint analysis to assess a patient's priorities when selecting a biologic medicine and then generates a personalized report that displays the rank order of attributes that matter most to an individual (14). The patient can share the report with his or her physician, who can review the information to quickly understand the patient's preferences.

Our study has limitations. First, we only recruited subjects from the United States; our findings may not be generalizable to patients with axSpA in other parts of the world. As many international rheumatology societies stress the importance of shared decision-making between patients and providers when choosing a treatment (3,7,28), additional studies in other countries examining axSpA therapy decision-making are warranted. Second, our study included patients with self-reported axSpA. However, in sensitivity analyses that only included data from those confirmed to have the condition at academic medical centers, the findings were largely similar to the primary analyses. Third, we limited the study to eight attributes. Patients may have other considerations when selecting an axSpA therapy (eg, length of time since drug approval, mechanism of action, risk of hepatitis B reactivation, etc) that were not included in the survey. However, this was by design because ACBC analysis surveys can become unwieldy with too many attributes, and we decided to focus on eight core attributes that were deliberately chosen based on prior literature (15-19,29,30) and input from content experts to capture the most important considerations patients weigh when selecting a therapy. Fourth, our conjoint analysis included medication profiles modeled after oral (ie, NSAIDs) as well as parenteral (ie, biologics) therapies. It is possible that patients' decision-making would have differed had the survey only included biologic options; this is worthy of further study, particularly among patients with axSpA who remain symptomatic despite NSAIDs and are considering biologics. Fifth, despite the interactive design of the survey and limitation to 20 conjoint vignettes, patients may have found the serial decision-making challenging. Similarly, patients with lower numeracy skills may have experienced difficulty interpreting the risks provided. It can be argued, however, that this exercise is at least comparable to clinic-based decision-making for determining patient preferences because patients may complete the survey at their own pace while carefully considering trade-offs.

In conclusion, we found that patients with axSpA highly value medication efficacy, cost, and route of administration when selecting from among the various therapeutic options. We also discovered that the decision-making process is highly individualized because sociodemographic and clinical characteristics poorly predict preferences. With the increasing number of therapeutic options becoming available for patients, these results underscore the need for development of treatment decision tools to enhance communication and shared decision-making between patients and providers. This will optimize selection of therapies that match

patients' unique preferences and may ultimately improve medication adherence and outcomes.

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## AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be published. Dr. Almario had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Novartis Pharmaceuticals Corporation had no role in the study design or in the collection, analysis, or interpretation of the data, the writing of the manuscript, or the decision to submit the manuscript for publication. Publication of this article was not contingent upon approval by Novartis Pharmaceuticals Corporation.

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