Short-term costs associated with non-medical switching in autoimmune conditions

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Abstract

Objective

To estimate short-term costs associated with non-medical switch (NMS) from originator biologics to biosimilars among stable patients with autoimmune conditions in rheumatology, gastroenterology, and dermatology from a US provider's and third-party payer's perspective.

Methods

An economic model was constructed to estimate switching costs related to physician time and healthcare resource utilisation (HRU) at the initial NMS visit and over 3 months. The proportion of patients with relevant conditions treated with originators and expected NMS rate, physician time, HRU, and payer reimbursement were derived from a physician survey. Switching costs were estimated for a practice of 1,000 patients with relevant conditions by therapeutic area and for an insurance plan with 1 million individuals by therapeutic area and all areas combined. Switching cost drivers were assessed with one-way sensitivity analyses.

Results

Physicians expected extra 6 minutes for the NMS visit and 22 minutes over 3 months; NMS rates of 14.4%, 15.5%, and 17.7%; and 11.3%, 16.2%, and 33.2% of time not reimbursed for gastroenterology, rheumatology, and dermatology, respectively. The total switching costs for payer's were $771,460 (for n = 3,609 patients with an NMS rate of 16.6%), mostly due to follow-up visits and additional laboratory tests/procedures. In sensitivity analyses, the NMS rate was the main cost driver. Increasing the NMS rate to 25% and 50% increased payer's total switching costs to $1.19 and $2.39 million, respectively.

Conclusion

Originator-to-biosimilar NMS in stable patients with autoimmune conditions could result in considerable switching costs for both providers and payers.

Key words

non-medical switch, biologics, biosimilars, switching costs

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Reprints will not be available from the authors.

Received on February 16, 2018; accepted in revised form on April 16, 2018.

Funding: financial support was provided by AbbVie. Writing assistance was provided by C. Metallo, PhD, and C. Qi, both employees of Analysis Group, Inc, and was paid for by AbbVie.

Competing interests:
M. Skup, M. Mittal, and A. Ganguli are employees and stockholders of AbbVie.
M. Yang and D. Macaulay are employees of Analysis Group, Inc., which has received consultancy fees from AbbVie for this study.
A. Gibofsky received consulting and speaker fees from AbbVie, Amgen, Celgene, Eli Lilly and Company, Genentech, Horizon, Iroko, Novartis, Pfizer and UCB; he is also a shareholder of AbbVie, Amgen, BMS, GSK, Horizon, J&J and Pfizer.

Introduction

Over the past two decades, biologic therapies have become the standard of care for the treatment of autoimmune inflammatory diseases, including rheumatic, gastrointestinal, and dermatologic diseases (1-5). The patent expiration of several biologics (6) has prompted the development of biosimilars, biologic products "highly similar" to approved biologics (*i.e.* originators) in terms of safety, effectiveness, immunogenicity, and pharmacokinetics (7, 8).

In the United States (US), the first biosimilar was approved in 2015, followed, so far, by four others (9). Because biosimilars are typically expected to be priced lower than their originators, they are likely to gradually gain traction in clinical practice (6). In particular, the potential cost savings associated with biosimilars are likely to incentivise payers, managed care organisations, and pharmacy benefits managers to adopt strategies that encourage the non-medical switch (NMS) from an originator to its biosimilar in stable patients, for instance by changing drug coverage, formulary placement, or copayments (6, 10, 11). While NMS has proved a successful strategy in lowering the prescription costs of small molecule generics (12, 13), biosimilars are not exact copies of their originators and thus do not compete with biologics just on cost but also on therapeutic equivalence. This may generate costs that are unique to biologic-to-biosimilar NMS (6). For instance, patients, pharmacists, and physicians may need to be educated on biosimilars and additional laboratory tests, dose adjustments, and follow-up visits may be required when switching patients whose condition is well-controlled with the originator biologic.

Biologic-to-biologic NMS has been linked to increased medical costs, hospitalisations, outpatient visits, and emergency room visits (10, 14, 15), raising the possibility that this may happen for biologic-to-biosimilar NMS as well. Given that biosimilars are expected to be priced only 15 to 30% lower than their originators (2), it is possible that non-drug related switching costs associated with originator-to-biosimilar NMS may minimise the cost savings stemming from the lower drug costs of biosimilars. However, the impact of originator-to-biosimilar NMS on healthcare resource utilisation (HRU) and switching costs has not been well characterised in the literature. To address this knowledge gap, an economic model was constructed to estimate the short-term switching costs and HRU associated with originator-to-biosimilar NMS among patients with rheumatic, gastrointestinal, and dermatologic autoimmune diseases in the US, from a provider's and a third-party payer's perspective.

Methods

An economic model was constructed to estimate the switching costs associated with NMS over a three-month period (Fig. 1). The model target population was stable patients with an autoimmune condition who experienced an originator-to-biosimilar NMS. The autoimmune conditions were in three therapeutic areas: rheumatology (rheumatoid arthritis [RA], psoriatic arthritis [PsA], and ankylosing spondylitis [AS]), gastroenterology (Crohn's disease [CD] and ulcerative colitis [UC]), and dermatology (plaque psoriasis and PsA).

Provider's perspective

From a US provider's perspective, NMS-related switching costs were defined as the total *unreimbursed* costs due to (1): the extra time, compared to a routine office visit, that physicians expected to spend during the NMS visit (*i.e.* when NMS was initiated) and during the 3 months following the NMS visit (follow-up); and (2) NMS-related laboratory tests and procedures prescribed at the NMS visit and during follow-up. The follow-up was chosen to be 3 months to be consistent with the monitoring interval recommended by clinical guidelines for patients with autoimmune conditions treated with biologics (16).

Assuming a practice comprising 1,000 patients with the conditions of interest, NMS-related switching costs were calculated for patients expected to undergo NMS and were estimated as cost per switched patient for each therapeutic area separately. The number of

NMS patients within the practice was derived from a physician survey, as detailed below.

Payer's perspective

From a US payer's perspective, NMS-related switching costs were defined as the total *reimbursed* costs, and were estimated for all the NMS patients within an insurance plan covering one million individuals. Within the insurance plan, the number of patients with the conditions of interest and, among them, those expected to undergo NMS, was calculated based on prevalence rates and a physician survey, as detailed below. Switching costs were estimated for each therapeutic area and for all areas combined.

Model assumptions

The model assumed that originator-to-biosimilar NMS had no impact on clinical outcomes (*i.e.* comparable efficacy and safety profile). The costs associated with the extra time during the NMS visit and for NMS-related laboratory tests and procedures were assumed to occur in an outpatient non-facility setting. Moreover, the model assumed a 100% reimbursement rate for laboratory tests and procedures or any extra NMS-related follow-up visits.

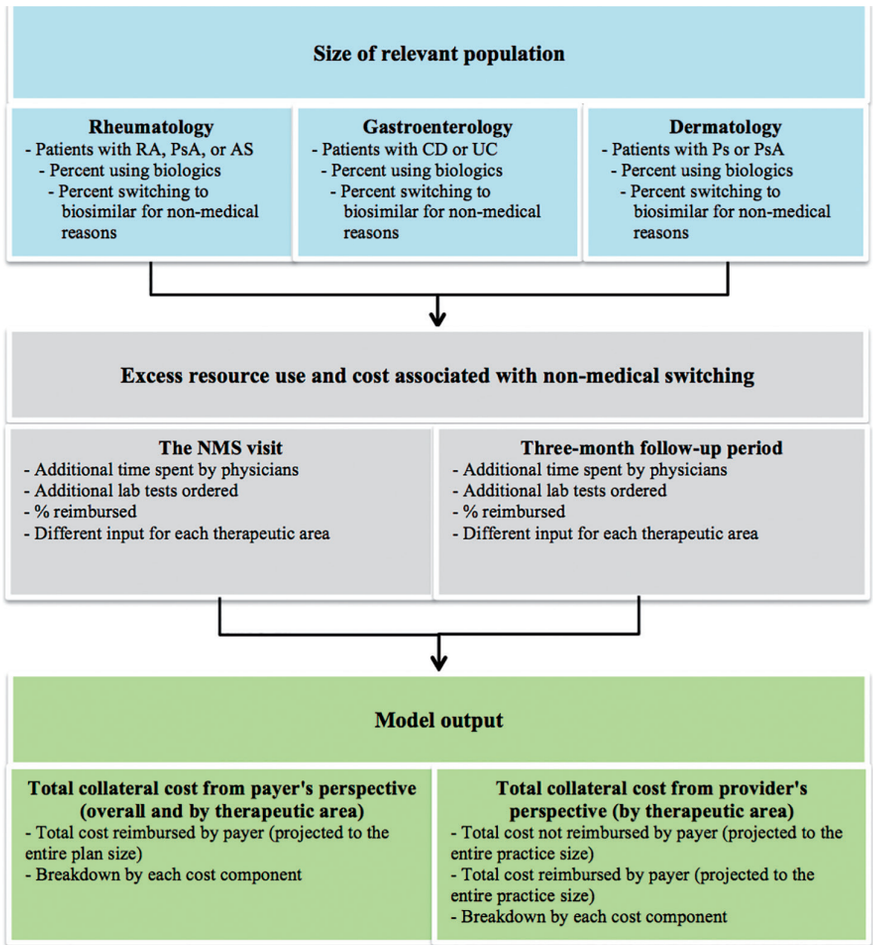

Fig. 1. Model schema.
RA: rheumatoid arthritis; Ps: psoriasis; PsA: psoriatic arthritis; AS: ankylosing spondylitis; CD: Crohn's disease; UC: ulcerative colitis.

Model inputs and data sources

The US prevalence rates of the conditions of interest were obtained from the literature (17-21) (online appendix) and were used to estimate the proportion of patients with the conditions of interest within a one-million-members insurance plan. The unit costs of physician time, laboratory tests, and procedures were based on the 2016 Medicare physician fee schedule published by the Centers for Medicare and Medicaid Services (CMS).

A survey was designed to collect information pertaining to originator-to-originator NMS and expected originator-to-biosimilar NMS among practicing rheumatologists, dermatologists and gastroenterologists in the US who had at least 3 years of experiences treating patients with the conditions of interest, had experience with biologic switching, and were aware of biosimilars. The survey collected data on the proportion of stable patients with the conditions of interest receiving biologics, expected rate of originator-to-biosimilar NMS among stable patients, extra time expected to be spent, additional laboratory tests/procedure for/at the NMS visit and follow-up visits, and the expected payer reimbursement rates for the physicians' extra time. Two physicians from each therapeutic area pilot-tested the survey to ensure the clarity and relevance of the questions in the survey.

Because at the time of the survey data collected (October 2016) no biosimilars for autoimmune conditions were available on the US market, the participating physicians would only have experience with originator-to-originator NMS. As such, the survey was designed to include two scenarios (1): originator-to-originator NMS: physicians were asked to answer the survey questions based on their experience (2); originator-to-biosimilar NMS: physicians were asked to answer the survey questions based on their expectations. To reduce the response burden and avoid potential confusion, physicians were randomly assigned to respond to one of the two scenarios.

Sensitivity analyses

One-way sensitivity analyses were conducted to assess the potential drivers of the switching costs for each perspective and by each therapeutic area. Key model inputs varied around the base-case value one at a time while keeping other inputs constant on the parameters and scenarios listed above.

Results

Survey participant characteristics

A total of 31 rheumatologists, 31 gastroenterologists, and 32 dermatologists

participated in the survey (Table I). On average, rheumatologists had 17.0 years of experience, gastroenterologists 15.6 years, and dermatologists 13.8 years. Nearly two-thirds of rheumatology patients were treated with biologics: 60.8% RA patients, 60.2% PsA patients, and 64.7% AS patients; 63.4% CD patients and 44.2% UC patients were treated with biologics; 37.2% psoriasis patients and 71.7% PsA patients were treated with biologics.

Across therapeutic areas, the five most common reasons for switching from one originator to another (not limited to NMS) (Table I) were lack of response (90.3–74.2%), tolerability/adverse events (80.6–53.1%), insurance coverage (58.1–29%), medication cost (45.2–19.4%), and patient preference (29.0–22.6%). The rate of originator-to-originator NMS was 27.1%, 15.1%, and 20.8% for rheumatology, gastroenterology, and dermatology patients, respectively; the expected rate of originator-to-biosimilar NMS was 15.5%, 14.4%, and 17.7%, respectively. The majority of rheumatologists (87.1%), gastroenterologists (80.6%), and dermatologists (87.5%) expected the NMS visit (originator-to-originator or originator-to-biosimilar) to last longer than a routine visit.

Table I. Physician and practice characteristics.

	Rheumatology (n=31)	Gastroenterology (n=31)	Dermatology (n=32)
Years of experience, mean (SD)	17.0 (9.9)	15.6 (8.5)	13.8 (8.4)
Hospital practice setting, n (%)	6 (19.4%)	14 (45.2%)	1 (3.1%)
Academic affiliation, n (%)	12 (38.7%)	20 (64.5%)	9 (28.1%)
Geographic region, n (%)			
West	6 (19.4%)	6 (19.4%)	10 (31.3%)
Midwest	6 (19.4%)	5 (16.1%)	3 (9.4%)
Northeast	8 (25.8%)	11 (35.5%)	7 (21.9%)
South	11 (35.5%)	9 (29.0%)	12 (37.5%)
Percentage of patients with each type of insurance,[a] mean (SD)			
Private, commercial	48.8% (22.6%)	50.5% (22.6%)	64.3% (20.4%)
Medicare	30.5% (15.8%)	27.5% (13.9%)	26.6% (15.4%)
Medicaid	14.8% (14.6%)	18.8% (17.7%)	5.5% (7.8%)
Uninsured	5.6% (8.6%)	4.0% (5.7%)	2.9% (3.7%)
Percentage of patients using biologics, mean (SD)			
Rheumatoid arthritis	60.8% (14.2%)		
Psoriatic arthritis	60.2% (16.0%)		
Ankylosing spondylitis	64.7% (18.5%)		
Crohn's disease		63.4% (17.2%)	
Ulcerative colitis		44.2% (14.1%)	
Psoriasis			37.2% (26.4%)
Psoriatic arthritis			71.7% (29.0%)
Among typical stable patients, mean (SD)			
Visits over 3-months	2.3 (3.7)	1.2 (0.7)	1.7 (1.2)
Typical visit time (minutes)	17.8 (4.9)	18.7 (5.9)	13.5 (4.4)
Reasons for NMS to another biologic product, n (%)			
Lack of response	23 (74.2%)	28 (90.3%)	26 (81.3%)
Tolerability/adverse events	23 (74.2%)	25 (80.6%)	17 (53.1%)
Insurance coverage	18 (58.1%)	9 (29.0%)	14 (43.8%)
Medication cost	14 (45.2%)	6 (19.4%)	9 (28.1%)
Patient preference	7 (22.6%)	9 (29.0%)	3 (9.4%)
Other[b]	0 (0.0%)	1 (3.2%)	0 (0.0%)
Expect NMS visits to take longer, n (%)	27 (87.1%)	25 (80.6%)	28 (87.5%)
Proportion of patients expected to NMS over the next twelve months, mean (SD)			
To another originator	21.1% (27.1%)	15.1% (19.0%)	20.8% (18.9%)
To a biosimilar	15.5% (20.2%)	14.4% (19.6%)	17.7% (15.4%)

NMS: non-medical switching; SD: standard deviation.
[a] 19 physicians reported being unsure of the percentage for at least one type of insurance.
[b] The "other" reported reason for a NMS from one biologic product to another was to respond to a change in pharmacy policy.

NMS-related resource utilisation and cost

NMS-related HRU was largely consistent in the two scenarios, albeit with some expected variations since, unlike an originator-to-biosimilar switch, an originator-to-originator switch may involve a change in mechanism of action and thus require more titration and monitoring time. Given the focus of this study on originator-to-biosimilar NMS, physician responses to this scenario were used as model inputs.

When averaging across therapeutic areas, physicians expected an NMS visit to take approximately 6 minutes longer than a routine visit, resulting in an additional average cost of $24 (rheumatology: $25; gastroenterology: $20; dermatology: $27) per patient; physicians expected approximately 17% of the time (rheumatology: 22%; gastroenterology: 16%; dermatology: 12%) to be reimbursed (Table II). In addition, physicians expected on average 3.8 NMS-related laboratory tests and procedures (rheumatology: 4.3; gastroenterology: 3.9; dermatology: 3.1), resulting in an additional $92 per patient (rheumatology: $85; gastroenterology: $135; dermatology: $58).

During follow-up, physicians estimated they would need to spend, on average, a total of 24 extra minutes, costing an average of $95 per patient (rheumatology: $104; gastroenterology: $90; dermatology: $90); of this cost, 58% of the associated time (rheumatology: 70%; gastroenterology: 60%; dermatology: 51%) was expected to be reimbursed (Table II). Across therapeutic areas, the majority of the extra time spent originated from follow-up visits and laboratory tests or procedures (rheumatology: 13 and 8 minutes out of 24 minutes; gastroenterology: 9 and 12 minutes out of 21 minutes; dermatology: 6 and 8 minutes out of 21 minutes). During the three-month follow-up period, physicians expected 5.2 NMS-related laboratory tests and procedures (rheumatology: 7.1; gastroenterology: 5.4; dermatology: 3.0), amounting to an additional $125 per patient (rheumatology: $99; gastroenterology: $224; dermatology: $58), all of which were assumed to be reimbursed in the model.

Table II. NMS-related resource utilisation and cost.

	Average time/tests per patient	Average cost per patient [a]	Percent reimbursed by payer	Cost per patient	
				Reimbursed	Not reimbursed
Rheumatology					
NMS visit					
Additional time spent by physician[b]	6 minutes	$25	22%	$5	$19
Additional lab tests and procedures	4.3 tests	$85	100%	$85	$0
Three-month follow-up period					
Additional time spent by physician[b]	24 minutes	$104	70%	$72	$32
Time from extra follow-up visits	13 minutes	$56	100%	$56	$0
Extra time spent for routine follow-up visits	3 minutes	$14	20%	$3	$11
Extra time spent on lab tests	8 minutes	$34	39%	$13	$21
Additional lab tests and procedures	7.1 tests	$99	100%	$99	$0
Total	**30 minutes**	**$313**	**84%**	**$262**	**$51**
Gastroenterology					
NMS visit					
Additional time spent by physician[b]	5 minutes	$20	16%	$3	$17
Additional lab tests and procedures	3.9 tests	$135	100%	$135	$0
Three-month follow-up period					
Additional time spent by physician[b]	21 minutes	$90	60%	$54	$36
Time from extra follow-up visits	9 minutes	$37	100%	$37	$0
Extra time spent for routine follow-up visits	1 minutes	$3	4%	$0	$29
Extra time spent on lab tests	12 minutes	$50	33%	$17	$24
Additional lab tests and procedures	5.4 tests	$224	100%	$224	$0
Total	**26 minutes**	**$469**	**89%**	**$416**	**$53**
Dermatology					
NMS visit					
Additional time spent by physician[b]	6 minutes	$27	12%	$3	$24
Additional lab tests and procedures	3.1 tests	$58	100%	$58	$0
Three-month follow-up period					
Additional time spent by physician[b]	21 minutes	$90	41%	$37	$53
Time from extra follow-up visits	6 minutes	$25	100%	$25	$0
Extra time spent for routine follow-up visits	7 minutes	$32	8%	$2	$29
Extra time spent on lab tests	8 minutes	$34	28%	$9	$24
Additional lab tests and procedures	3.1 tests	$58	100%	$58	$0
Total	**28 minutes**	**$233**	**67%**	**$156**	**$77**
Overall [c]					
NMS visit					
Additional time spent by physician[b]	6 minutes	$24	17%	$4	$20
Additional lab tests and procedures	3.8 tests	$92	100%	$92	$0
Three-month follow-up period					
Additional time spent by physician[b]	22 minutes	$95	58%	$55	$40
Additional lab tests and procedures	5.2 tests	$125	100%	$125	$0
Total	**28 minutes**	**$336**	**82%**	**$276**	**$60**

NMS: non-medical switching.
[a] The cost per minute of extra time spent by physician was $4.25 and was calculated using the non-facility price for outpatient visits of established patients from the CMS physician fee schedule.
[b] The additional time spent during the NMS visit was calculated as the difference between the total time of the NMS visit and the total time needed for a typical routine visit.
[c] The overall resource utilisation and cost associated with NMS were calculated as an average across all three therapeutic areas. These estimates were not weighted by the number of patients expected to undergo NMS in each therapeutic area."

Combining results from the NMS visits and three-month follow-up, on average, the total extra time that physicians expected to spend due to NMS was 28 minutes (rheumatology: 30; gastroenterology: 26; dermatology: 28), resulting in an average cost of $336 per patient (rheumatology: $313; gastroenterology: $469; dermatology: $233); of this cost, $276, 82.1% (rheumatology: $262, 82.7%; gastroenterology: $416, 88.7%; dermatology: $156, 67.0%) was expected to be reimbursed (Table II).

NMS-related switching costs: provider's perspective

It was estimated that patients treated with an originator were 61.1% for rheumatology, 53.5% for gastroenterology, and 44.0% for dermatology; of these, physicians expected that 15.5%, 14.4%, and 17.7% of rheumatology, gastroenterology, and dermatology patients could switch to a biosimilar, respectively (Table III). The total NMS-related costs were estimated at $29,700 for rheumatology, $36,083 for gastroenterology, and $18,184 for dermatology within a practice of 1,000 pa-

Table III. NMS-related short-term switching costs to payers and providers [a].

Provider perspective	Number of patients with conditions of interest		Total cost	Switching cost	Percent unreimbursed
	Using originator biologics	Switching to biosimilars			
Rheumatology	611 (61.1%)	95 (15.5%)	$29,700	$4,825	16.2%
Gastroenterology	535 (53.5%)	77 (14.4%)	$36,083	$4,061	11.3%
Dermatology	440 (44.0%)	78 (17.7%)	$18,184	$6,041	33.2%

Payer perspective	Number of patients			Total switching cost
	With conditions of interest	Using originator biologics	Switching to biosimilars	
Rheumatology	11,900 (1.2%)	7,356 (61.8%)	1,141 (15.5%)	$298,754
Gastroenterology	5,000 (0.5%)	2,670 (53.4%)	384 (14.4%)	$159,691
Dermatology	33,500 (3.4%)	13,310 (39.7%)	2,359 (17.7%)	$367,234
Overall [b]	47,900 (4.8%)	21,688 (45.3%)	3,609 (16.6%)	$771,460

[a] From the provider's perspective, the numbers of patients with conditions of interest was calculated using the reported disease breakdown within each provider's practice reported in the survey together with the specified practice size. Estimations were based on an assumed practice size of 1,000 patients for a therapeutic area from the provider's perspective and an assumed one million covered lives for an insurance plane from the payer's perspective.

[b] Because PsA can be treated either by dermatologists or rheumatologists, for the overall population, the number of PsA patients was calculated as the weighted average from the two specialties. As a result, the overall results do not equal the sum of the results by specialty

tients. Of these costs, $4,825 (16.2%), $4,061 (11.3%), and $6,041 (33.2%) were NMS-related switching costs (*i.e. unreimbursed*) for rheumatologists, gastroenterologists, and dermatologists, respectively.

NMS-related switching costs: payer's perspective

Within a one-million-members insurance plan, patients with the condition of interest were 11,900, 5,000, and 33,500 for rheumatology, gastroenterology, and dermatology, respectively (Table III). Patients on an originator were 7,356 (61.8%), 2,670 (53.4%), and 13,310 (39.7%) for rheumatology, gastroenterology, and dermatology, respectively; of them, 1,141 (15.5%), 384 (14.4%), and 2,359 (17.7%) patients were estimated to switch to a biosimilar, respectively. The resulting NMS-related switching costs (*i.e.* total *reimbursed cost)* amounted to $298,754 for rheumatology, $159,691 for gastroenterology, and $367,234 for dermatology. Combining all three therapeutic areas (accounting for the fact that PsA patients may be treated by either rheumatologists or dermatologists), the total NMS-related switching costs were $771,460 for the entire insurance plan.

Sensitivity analysis

In sensitivity analyses, results were consistent from provider's and payer's perspectives (Fig. 2). In both perspectives, the proportion of patients switching to biosimilars was the main cost driver. By increasing the switching rate to 25% and 50%, total switching cost increased by 183-222% for providers and resulted in $1.19 million and $2.39 million for payers.

From the provider perspective, another important cost driver was the extra time physicians spent during the NMS visit. From the payer perspective, the total number of patients with the conditions of interest and the unit costs of laboratory tests and procedures were also found to be substantial cost drivers.

Discussion

Due to their lower price, biosimilars are expected to reduce healthcare costs and improve patients' access to costly biologic therapies (6, 22-24). However, drug costs represent only one aspect of the total healthcare costs and biologic switching from an originator to its biosimilar is likely to be associated with additional costs to ensure a successful switch. To evaluate the extent to which switching costs may influence the overall costs associated with NMS, this model-based study estimated the short-term switching costs associated with originator-to-biosimilar NMS among stable patients with autoimmune conditions in the US, from a provider's and a payer's perspective.

The results of this study showed that, over a three-month period, originator-to-biosimilar NMS can have a considerable impact on HRU and costs. Indeed, physicians reported to expect extended office visit time, extra time during follow-up visits, and additional laboratory tests and procedures. Providers were mostly affected by the extra time spent on managing the NMS-related process – from planning for NMS to evaluating post-switch outcomes – as only a small fraction of this time was expected to be reimbursed; the resulting NMS-related short-term costs ranged from $4,061 to $6,041 per practice across therapeutic areas. On the other hand, payers were mostly affected by the additional laboratory tests and procedures that physicians expected to be necessary to start NMS and then monitor patients in the following three months.

To date, the switching cost burden of originator-to-biosimilar NMS has not been well characterised. In one recent UK modelling study evaluating NMS from infliximab to its biosimilar from a payer's perspective, NMS-related switching costs (mostly associated with dose adjustments and implementation of the biosimilar regimen) were estimated at approximately $2,800 (2016 USD) per patient over one year; the authors concluded that no savings were derived from NMS (25). In the present study, practicing physicians expected a switching per-patient cost of $336 over three months. This difference between the UK study and our study is likely due to differences in time horizons (one year *vs.* 3 months), biologic treatments considered (one biologic treatment *vs.* biologic treatments in general in three therapeutic areas), and inputs (from the NICE technology appraisal of the infliximab biosimilar *vs.* direct inputs from physicians). Moreover, the unit costs in the present study were obtained from the CMS physician fee schedule, which are typically lower

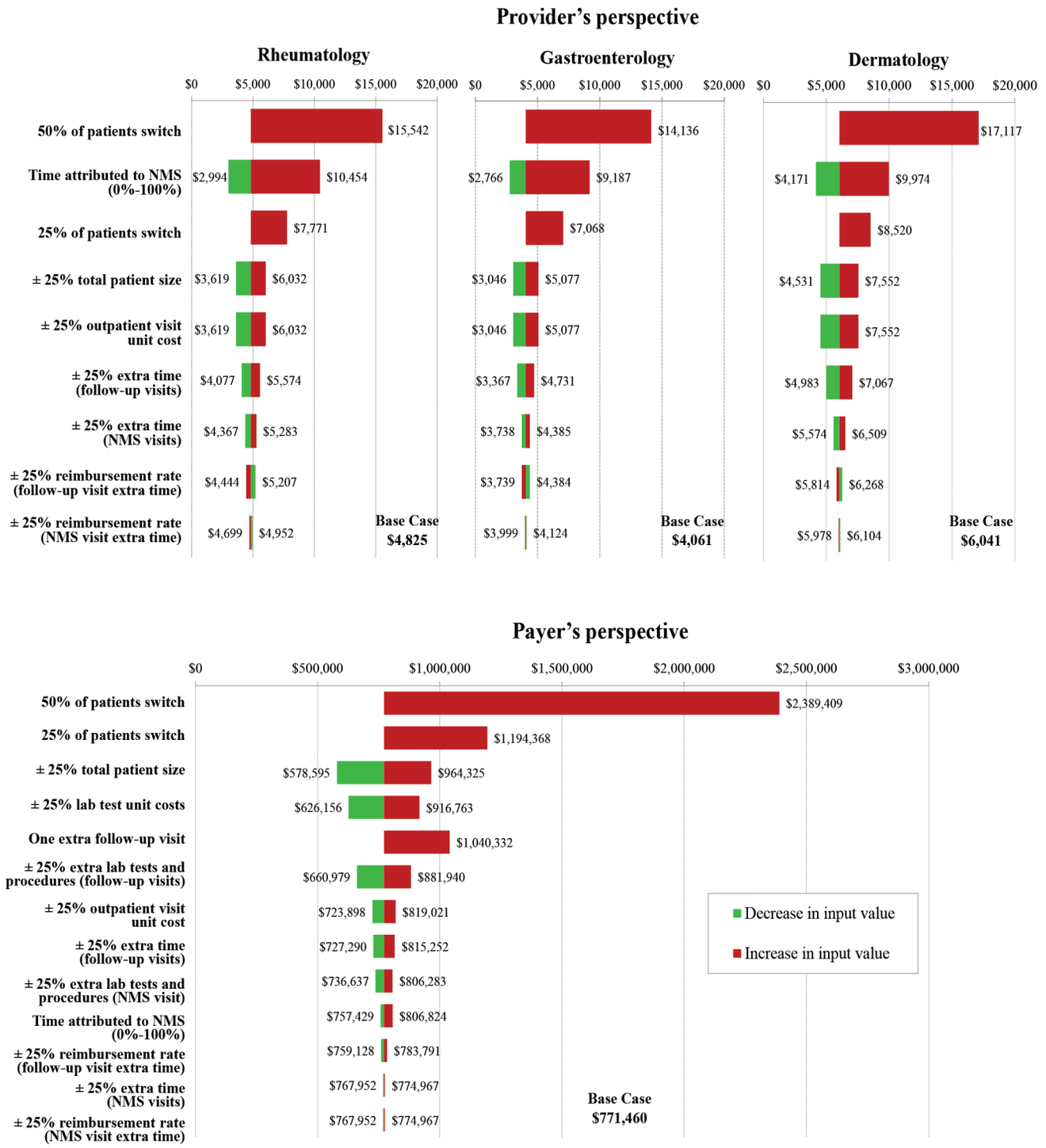

Fig. 2. Sensitivity analyses.

than those used by commercial payers. It should be noted that this study did not include all possible costs associated with switching. For instance, during the course of three separate interviews with nurses that were conducted as part of this study, it was found that originator-to-biosimilar NMS is expected to be associated with extra time for administrative paperwork (*e.g.* pre-authorisation, insurance, and billing paperwork), providing training on biosimilars to both nurses and patients, preparing educational materials related to biosimilars, and dealing with potential pushback from patients. As such, the current model is likely to have underestimated the total switching costs of NMS. While biosimilar manufacturers may ultimately absorb some switching costs, further studies are needed to characterise both

reimbursable and non-reimbursable switching costs of originator-to-biosimilar NMS. This is especially important as biosimilars are far from yielding the typical 70% to 90% in drug cost reduction provided by small molecule generic medications (10, 26). In Europe, biosimilars have been generally priced 20–30% lower than their originators while, in the US, the first approved biosimilar was priced 15% lower than its originator filgrastim (2, 10). These relatively moderate price reductions highlight the potentially important role that switching costs may play in fully characterising the economic implications of originator-to-biosimilar NMS.

While existing data on the costs of originator-to-biosimilar NMS are scant, the economic outcomes of originator-to-originator NMS have been more extensively investigated and may provide some important insights into the consequences of switching to a similar, but not identical, biologic product (10). In the case of CD, RA, UC, PsA, and AS, originator-to-originator NMS has been linked to increased HRU (*e.g.* emergency room and outpatient visits) (14, 15, 27) and medical costs (28) up to one year after switching. Moreover, an analysis of the Institute for Patient Access found that Medicare patients with RA who switched to a less expensive drug for cost-related reasons incurred a greater increase in yearly medical costs compared to patients who maintained the same course of treatment ($14,127 *vs.* $201) (29). Taken together, these data appear to suggest that switching patients from one treatment to another for non-medical reasons may have long-term economic implications, regardless of treatment and disease type. Indeed, even the switch from brand to generic small molecule medications has been associated with an increase, not a decrease, in medical costs if not medically motivated (30). It could be reasonable to assume that similar results may apply to switching from an originator to a biosimilar, particularly in the long term. Given that the current study was designed to assess the switching costs of originator-to-biosimilar NMS only over the short term, future studies will need to include longer follow-ups to evaluate switching costs over longer post-NMS periods.

The study findings should be interpreted with caution. This is an economic model study involving a series of assumptions, though sensitivity analyses showed the robustness of the results. One main assumption was that originator-to-biosimilar NMS had no impact on effectiveness and safety. It should be noted that biosimilar medications are approved on the premise of biosimilarity but not interchangeability. Evidence is yet to be established with regard to the legitimacy of NMS, which is beyond the scope of the current study. However, from a payer's perspective, NMS is to be anticipated due to the lower price of biosimilars; thus, it is important to understand the cost impact of NMS. The model focused on short-term switching costs from the perspective of treating physicians and did not include that of other staff such as nurses and administrative staff and did not consider drug costs (pharmacy benefit managers and insurers usually receive rebates from manufacturers for originator biologics). These may have led to underestimate the switching cost burden of originator-to-biosimilar NMS. Additionally, as evidenced in a UK modelling study (25), there could be separate costs from an institution's perspective when implementing a NMS program that this study did not include. Furthermore, the model was developed from the perspective of payers and providers in the US and, thus, may not be generalisable to other countries given differences in healthcare systems. Additionally, this model only estimated the short-term switching costs, which are associated with the single action of switching. Therefore, no statistical comparisons were conducted. Lastly, since, at the time of the physician survey, there were no biosimilars on the US market for the autoimmune conditions included in the model, the physician responses to the originator-to-biosimilar NMS scenario outlined in the survey were based on expectations. However, this limitation was mitigated by the fact that all the survey respondents were physicians with experience in biologics and NMS and that physicians' responses in the originator-to-biosimilar NMS scenario were similar to those provided by different physicians in the originator-to-originator NMS scenario.

Conclusion

This study found that, in stable patients with autoimmune conditions, originator-to-biosimilar NMS may be associated with substantial switching costs from both a provider's and payer's perspectives, regardless of therapeutic area. While more research on the topic is needed, the results of this study provide important and timely information on the possible economic impact of originator-to-biosimilar NMS on payers, providers, and, ultimately, patients.

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