

# Evaluation of Newly Designed Blister Packs for Easier Handling to Prevent Pill Dropping

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**Background:** Blister packs with paperboard backing, which is useful for displaying instructions and information, are the most popular type of packaging for osteoporosis drugs in Japan. However, the main users of drugs are the aged, who often find blister packs difficult to open or drop their pills during opening. In this study, we compared different types of blister packs in terms of usability and handling.

**Methods:** We conducted a subjective and objective study to compare commonly used blister packs with newly designed ones that have a jagged notch designed to hold a pill temporarily and a perforated line that enables the pack to be held easily in one hand. Regarding subjective data, packaging and sensory tests were performed. The participants in the sensory test were healthy older adults and patients with rheumatoid arthritis (RA). We also measured the pinch power of all participants.

**Results:** A comparison of several items, including opening status, prevention of pill dropping, and understanding of the instructions, using a numerical rating scale revealed no significant differences between ordinary (type A) and newly designed (type B) packaging. However, the scores for type B were the same or better than those for type A for every evaluation item. In addition, more than 85% of the participants reported preferring to use type B. More than 80% of the participants in both groups reported dropping pills using type A, which seemed to be related to their preference for type B. In the evaluation by the examiner (objective study), all participants could successfully remove their pills without dropping using type B, including those in the RA group who had difficulty handling packages.

**Conclusion:** These findings suggest that the new type of blister pack assessed in this study (type B) is preferable among older and shows promise for a universal design.

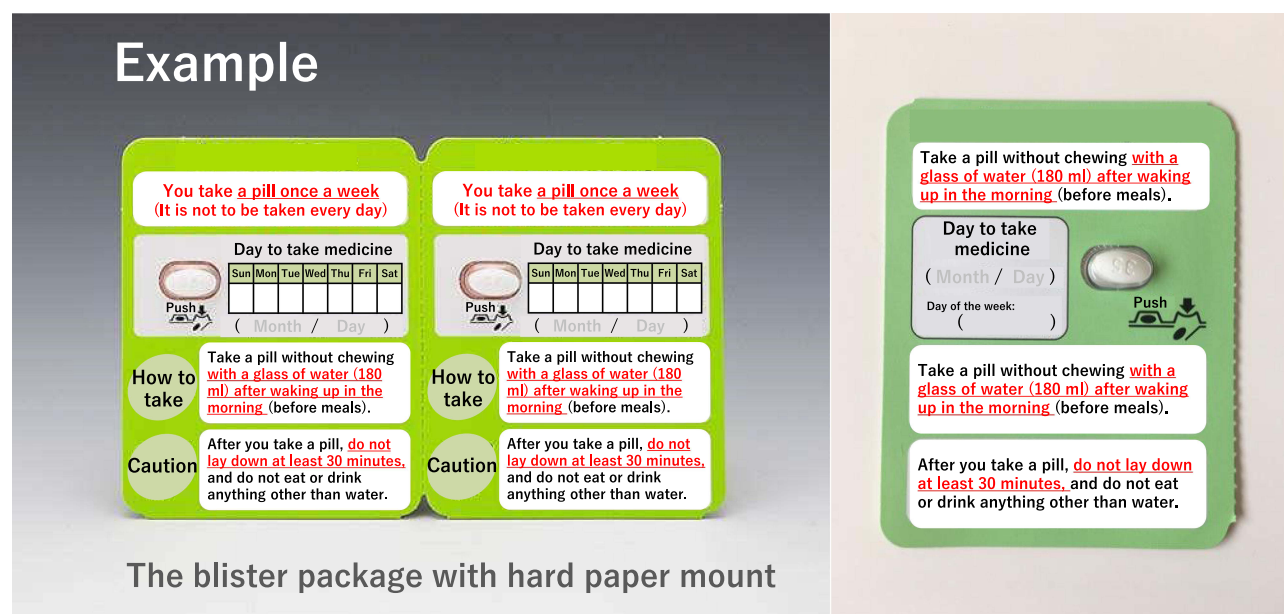
**Keywords:** drug packaging, paperboard backing, older adults, new design, rheumatoid arthritis, universal design

## Plain Language Summary

As a rheumatologist, I have experienced many patients with rheumatoid arthritis, especially older patients, having difficulties handling drugs. Most patients in Japan on medication, including prescription and over the counter drugs, are older adults who frequently live alone or with a partner; therefore, drug packages designed for easier handling could be a priority issue in terms of promoting better drug adherence, such as for osteoporosis drugs. In this study, we compared new packaging designs with existing ones to examine objective and subjective differences in terms of ease of use. The results indicated that the new design was favorably evaluated and preferred among patients. For older patients who take medication every day, easier to use drug packaging could help reduce stress in their daily lives. These findings suggest that the use of new technologies and simple innovations in drug packaging could improve ease of use, promote the further implementation of cost-effective therapies, and provide more sustainable support for older patients.

## Introduction

In association with various medication needs, such as safe medication for children and the aged, medical packaging plays an important role.<sup>1-3</sup> Particularly, senior-friendly medical packaging is highly demanded in modern society, as older adults are the main users of various drugs. As most patients manage their own drug-taking independently, it is difficult to identify problems in their daily drug-taking. For many osteoporosis and rheumatoid arthritis (RA) drugs, the timing varies and must be followed carefully, so care workers and family members must maintain awareness of drug schedules.



**Figure 1** Blister pack with drug instructions.

Not surprisingly, evidence of difficulties in package-opening, catching and holding pills, and following instructions has been reported.<sup>4</sup> Therefore, more manageable and cost-effective strategies are needed.

At present, blister packs with paperboard backing, which is useful for displaying important instructions and information (eg, dosage amount, dosing schedule), are the most popular type of packaging for osteoporosis drugs in Japan since this information is essential for ensuring safety for older users. However, the main users of drugs are the aged, who typically need to use both hands to open blister packs and thus cannot maintain a firm hold on the packaging. As a result, they often find blister packs difficult to open or drop their pills during opening.<sup>5</sup> This situation is obviously not desirable and may cause stress for older adults. In addition, some patients with RA complain that if they drop a pill, it is difficult to find because of poor eyesight, limited mobility, or functional impairments of the hands. To help prevent pill dropping and promote easy package opening for such users, even those with disabilities, blister packs with high usability are desired.<sup>6</sup>

## Objective

To evaluate the usability of newly designed blister packs for easier handling to prevent pill dropping, we conducted a subjective and objective study to compare popular types of blister packs (type A) with new ones (type B) (Figures 1–4).

## Materials and Methods

Subjective data were obtained from sensory tests and packaging for ordinary-type packaging (type A) and new type-packaging (type B). The participants in the sensory test were 10 healthy older volunteers (mean age  $\pm$  standard deviation [SD],  $73.4 \pm 3.3$  years) who had no deformities of the hands and fingers and were taking drugs daily, and 11 patients with RA (mean age  $\pm$  SD,  $66.0 \pm 7.8$  years) who were not acute patients and had more than a 6-month history of drug therapy. Eight patients had some deformity of the fingers. As for the RA stage in the joints, nine were stage IV and two were stage III according to Steinbrocker's criteria (1949). The patients with RA volunteered to participate in the study through a patients' meeting. By chance, all participants were female, mainly because around 80% of patients with RA are female. We used a numeric rating scale (NRS) to assess several items related to the quality and usability of the packaging (Tables 1 and 2). In this study, we try to avoid an order bias, so some participants started the study using type A packaging and others with type B. We also measured the pinch power of all participants using a digital handheld dynamometer (Isoforce GT-300; OG GIKEN Co., Ltd., Okayama, Japan). Differences were evaluated using *t*-tests. All

### Type A (ordinary type): The way to remove the pill and its difficulty

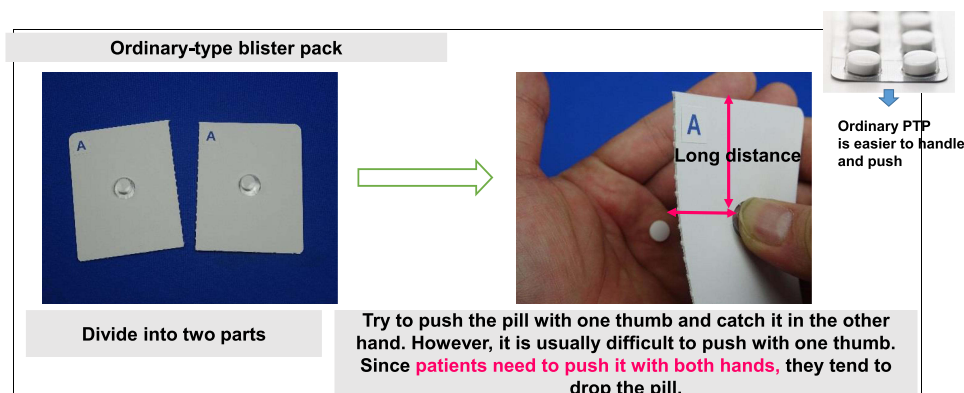


Figure 2 Type A (ordinary type).

### Type B (new design type): The way to remove the pill and its difficulty

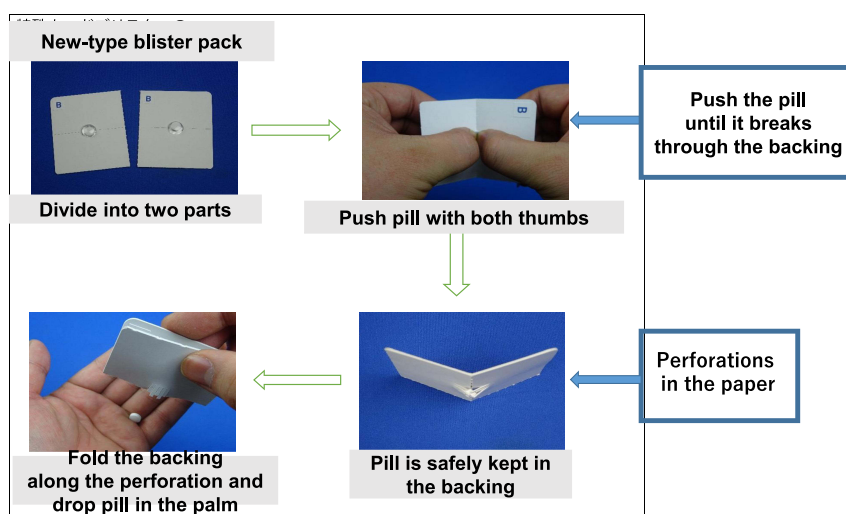


Figure 3 Type B (new design type).

statistical analyses were performed using GraphPad Prism 9 software (GraphPad Software Inc., San Diego, CA). A P-value of less than 0.05 was considered to indicate statistical significance. This study was approved by the Sadamoto Clinic Institutional Review Board (approval No. 1802) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

## Results

Tables 3 and 4 show the results regarding the packaging evaluations by the healthy older adults and those with RA, and Table 5 shows their experiences concerning package handling. The evaluations, including opening status, prevention of pill dropping, and instructions, were scored using an NRS (from 0 to 10, with 10 being the best).

The results indicated that not only patients with RA, but also healthy older adults, had various difficulties opening and handling the packages (Tables 3–5). Overall, 80% of healthy older adults and 82% of patients with RA dropped their pills when handling the packages (Table 5). Significant differences in pinch power were found between the two groups (healthy older adults,  $62.6 \pm 15.2$  N vs patients with RA,  $26.2 \pm 17.0$  N,  $P < 0.001$ ), which resulted in higher average scores for opening status among healthy older adults compared with patients with RA for both types A and B (Tables 3



Figure 4 Type B: enlarged photo.

and 4). In addition, 50% of healthy older adults and 45% of patients with RA reported using some type of personal devices to improve ease of opening (Table 5). Moreover, 40% of healthy older adults and 82% of patients with RA used their own devices to help them remember to take their drugs in daily life (Table 5). Regarding the management of drug taking, 90% of healthy older adults and 100% of patients with RA managed their own drug-taking (Table 5).

Table 1 Evaluation Scores Based on an NRS

NRS: Numerical Rating Scale 0–10			NRS: 1–3	
NRS	Difficulty Level of Removing Pills from the Blister Pack	Evaluation of Handling the Blister Pack	NRS	Evaluation of Instructions for the Blister Pack
0	Impossible to remove pills		1	It is difficult to understand how to use it with the instructions
1	Very difficult (higher)	It is difficult to take pills according to the instructions		It is possible to make a mistake
2	Very difficult	It is difficult to take pills according to the instructions		
3	Difficult (higher)	It is quite difficult to take pills without dropping or forgetting	2	It is understandable enough to use the instructions
4	Difficult	It is quite difficult to take pills without dropping or forgetting		
5	Not so difficult, not so easy (higher)	It is possible to take pills according to the instructions without difficulty		There is a very low possibility to make a mistake for most users
6	Not so difficult, not so easy	It is possible to take pills according to the instructions without difficulty	3	It is very understandable to use the instructions
7	Quite easy to remove pills (higher)	It is possible to take pills without a mistake		
8	Quite easy to remove pills	It is possible to take pills without a mistake		
9	Very easy to remove pills (higher)	It is easy to remove pills		The instructions are very easy for everybody
10	Very easy to remove pills	It is easy to remove pills		

**Table 2** Evaluation Items

No.	Item	①	②	③
1	Is the size of the packaging appropriate?	Too big	Too small	Appropriate
2	Do you usually take pills with PTP?	Yes	No	
3	Do you have experience using large blister PTP?	Yes	No	
4	Have you invented something to promote regular drug-taking? (self-made device)	To prevent forgetting to take	For easy opening and handing	Not particularly
5	Do you find it difficult to open drug packaging?	PTP	Packaging, not PTP	Not particularly
6	Do you have experience to drop pill when you use packages?	Yes	No	
7	Who manages your regular drug taking?	Myself	Family	Others

Concerning the packaging evaluations, the new type of blister packs received high scores from both the healthy older adults and the patients with RA (Tables 3 and 4). To help prevent biases, some patients were requested to open type A first and other patients were requested to open type (B) first; however, no difference in evaluation scores was observed between those who started with type A and those who started with type B. A comparison of opening status and understanding of the instructions between the older adults and patients with RA for types A and B using an NRS

**Table 3** Evaluations by the Healthy Older Adults

Item/No.	1	2	3	4	5	6	7	8	9	10
Age/Sex	75/M	75/M	73/M	79/M	72/M	77/FM	67/FM	73/FM	71/FM	72/FM
Dominant hand/pinch power [N]	R/100	R/57	R/67	R/57	R/57	R/43	R/67	R/50	R/65	R/63
Order	A→B	B→A	A→B	B→A	A→B	B→A	A→B	B→A	A→B	B→A
Opening status										
A	4	10	6	7	3	10	6	9	3	4
B	8	10	5	5	8	10	9	5	7	9
Dropping prevention										
A	7	9	6	6	5	10	7	9	5	8
B	9	8	6	8	8	10	9	5	6	7
Instructions										
A	2	3	3	3	2	3	2	3	2	3
B	2	3	3	3	2	3	2	3	2	3
1. Packaging size	①	③	①	①	①	③	③	①	①	①
2. Experience with PTP	①	①	①	①	①	①	②	②	①	①
3. Experience with PTP	②	①	①	①	①	①	②	①	②	②
4. Personal device	③	③	②	②	①	①, ②	③	③	①, ②	①, ②
5. Opening difficulty	①	②	③	③	③	③	③	③	③	①
6. Experience of dropping pills	①	①	①	①	①	①	②	①	②	①
7. Manager of drug-taking	②	①	①	①	①	①	①	①	①	①

**Notes:** Scores for "Opening status", "Dropping prevention", and "Instructions" are the numerical rating scale values shown in Table 1. Numerical responses to the questionnaire items (1–7) in the table are the same as the evaluation score shown in Table 2.

**Abbreviation:** PTP, press-through package.

**Table 4** Evaluations by Patients with RA

Item/No.	11	12	13	14	15	16	17	18	19	20	21
Age/Sex	65/FM	61/FM	65/FM	60/FM	60/FM	80/FM	76/FM	75/FM	56/FM	60/FM	FM
Dominant hand/pinch power [N]	R/66	L/20	R/17	R/30	R/33	R/43	R/28	R/11	R/11	R/7	L/22
Order	A→B	B→A	A→B	B→A	A→B	B→A	A→B	B→A	A→B	B→A	A→B
Opening status A	3	9	4	2	4	3	4	2	5	0	9
B	9	9	3	3	8	6	2	9	1	3	6
Dropping prevention A	5	9	6	3	6	8	3	4	1	1	8
B	8	10	7	4	9	7	4	9	1	5	6
Instructions A	2	3	3	3	2	2	2	1	3	3	2
B	2	3	3	2	3	2	1	2	3	3	2
1. Packaging size	③	③	③	①	①	③	③	③	③	③	③
2. Experience with PTP	①	①	①	①	①	①	①	①	①	①	②
3. Experience with PTP	②	①	①	①	①	①	①	①	①	①	②
4. Personal device	①, ②	①, ②	①	①	③	①	①	②	①	①, ②	①, ②
5. Opening difficulty	③	③	①, ②	③	③	③	①, ②	①, ②	①	①	③
6. Experience of dropping pills	①	②	①	①	①	①	①	①	①	①	②
7. Manager of drug-taking	①	①	①	①	①	①	①	①	①	①	①

**Notes:** Scores for “Opening status”, “Dropping prevention”, and “Instructions” are the numerical rating scale values shown in Table 1. Numerical responses to the questionnaire items (1–7) in the table are the same as the evaluation score shown in Table 2.

**Abbreviations:** RA, rheumatoid arthritis; PTP, press-through package.

revealed no significant differences. However, a significant difference was found in the prevention of pill dropping between the older adults and patients with RA for type A ( $7.2 \pm 1.6$  vs  $4.9 \pm 2.8$ , respectively,  $P < 0.05$ ), but not for type B (Figure 5). The scores for type B were the same or better than those for type A (from 63% to 81%) for every evaluation item (Table 6). The observations by the examiner revealed that all participants, including those in the RA group, could successfully remove their pills from type B without dropping.

## Discussion

The results of this study indicate that healthy older adults and patients with RA experience various difficulties in handling drug packages (Tables 3–5). Particularly, a high percentage of participants reported difficulties in opening drug packaging, which suggests the possibility of various problems related to drug-taking and adherence.<sup>7,8</sup> These situations are closely related in that healthy older adults and patients with RA both make substantial efforts in terms of drug-taking in their daily lives, including the use of personal devices to improve the ease of opening (Table 5).<sup>9,10</sup> Patients with RA tend to have weak pinch power, so these issues could pose more serious problems. The fact that a high percentage of patients use their own devices also suggests the need for better drug-taking support. In fact, 90% of the older adults and 100% of the patients with RA in this study were taking their drugs independently, which suggests the possibility of other problems developing or already present (Table 5).

As the problems associated with the handling of drug packaging remain somewhat hidden, users are forced to make various attempts to solve them themselves.<sup>11–13</sup> Assuming critical everyday drug taking situations among the aged and patients with RA, blister packs with improved usability are an urgent solution for lessening their daily burden.<sup>12</sup>

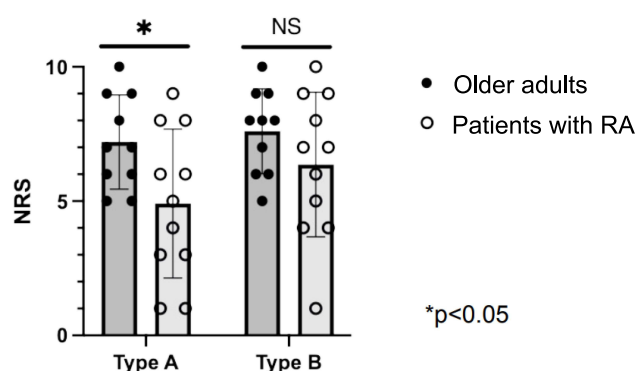


**Table 5** Summary of Evaluations Among Older Patients and Those with RA

	Older Patients	Patients with RA
1. Package size	80% appropriate	73% appropriate
2. Experience of common use PTP	80% had experience of use	91% has experience to use
3. Experience of large PTP	60% had experience of use	82% has experience to use
4. Personal device (self-made)	50% for easy opening, 40% to prevent forgetting to take	Personal device (self-made): 45% for easy opening, 82% to prevent forgetting to take
5. Experience of opening difficulty	30%	45% and 27% had various difficulties
6. Experience of pill dropping	80%	82%
7. Manager of drug-taking	90% managing drug-taking by themselves	100% managing drug-taking by themselves
<b>Free comments from the participants</b>		
1	It is easy to remove pills using type B packaging.	
2	I could easily break the backing of type B with both hands, and I was impressed the pill came out effortlessly.	
3	As the backing of type B was relatively thick, it was hard to take out the pill, but it prevents dropping, which is very good.	
4	I expect cheap packaging, so if a package like this with good usability is the same price, I am satisfied.	
5	I could remove the pill from type B smoothly, but not as smoothly from type A. ( <b>4 participants</b> )	
9	Because the perforation was firm in type B, I was not able to break it with one hand.	
10	The backing of type B was hard, so I think the pill would be easier to remove if were a little softer.	
11	I expected the backing of type B to be softer because my fingers are weak.	

**Abbreviations:** RA, rheumatoid arthritis; PTP, press-through package.

The participants in this study could use and understand the instructions of type B packaging even though they had never seen this type before, which suggests the improved usability of type B, even among the aged. As the new design is not dramatically different in size and shape from commonly used packaging, it could be adopted relatively easily with limited instructions and images (Figure 4).



**Figure 5** Evaluation of the prevention of pill dropping using a numerical rating scale. A significant difference was found in the prevention of pill dropping between the older adults and patients with RA for type A (an asterisk(\*) indicates  $P < 0.05$ , Welch's t-test).

**Table 6** The Percentage of Scores for B is the Same or Better Than A

	Ordinary Elderly	Rheumatoid Arthritis
Opening status	70%	63%
Prevention of pill dropping	80%	82%
Understand the instructions	80%	81%

**Abbreviations:** RA, rheumatoid arthritis; NRS, numerical rating scale.

A comparison of opening status and understanding of the instructions between the older adults and patients with RA for types A and B using an NRS revealed no significant differences. However, a significant difference was found in the prevention of pill dropping for type A, but not for type B (Figure 5). This finding indicates that even patients with RA can use the new type B with the same level of pill dropping, which would be a substantial improvement for individuals with joint problems. Furthermore, as mentioned above, the scores for type B were the same or better than those for type A (from 63% to 81%) for every evaluation item (Table 6); these results are consistent with the many positive comments about type B, including its easy handling and prevention of pill dropping, that were received from both the healthy older adults and patients with RA (Table 5), all of whom reported having the experience of pill dropping many times.<sup>14</sup> Therefore, packaging that is easier to handle can help prevent pill drops, and this could represent an essential type of support.

In the evaluation by the examiner (objective study), all participants could successfully remove their pills without dropping using type B, including those in the RA group. Regarding the opening status, since patients with RA have weaker pinch power, their average score was lower than that for the healthy older adults; however, they were able to use the new packaging easily when following the instructions, which was a main objective of designing a new type of blister pack. Particularly, the fact that patients with RA could open and handle the new packaging was highly valued.<sup>15–17</sup>

In even the first trial of new type of packaging, more than 90% of the free comments by both groups were positive, indicating that they had no problems concerning use. Adherence factors, including patients, medication, health-care providers, health-care systems, and socioeconomic status, have been reported.<sup>8,18</sup> Considering that drug adherence is a crucial component in the treatment of chronic diseases among older patients and those with disabilities, improving medication-related factors represents one of the most practical and direct types of support for users.

## Conclusion

This study evaluated the usability of a new type of blister pack. Since blister packs with paperboard backing are the most popular type of packaging for osteoporosis and RA drugs in Japan, improved usability is in high demand. Based on the results of the evaluations, the new type of blister pack assessed in this study shows promise for a universal design. The new package design is not expensive to produce, provides better usability, and improves adherence; therefore, it could contribute to more appropriate and cost-effective therapy and benefit not only individuals, but also the overall costs of medical care.

The main consumers of prescription drugs around the world are older adults, who naturally have various difficulties in daily life, including drug-taking.<sup>12,19</sup> However, the rapid development of innovations in medicine has been providing useful therapeutic options with various administration methods. Therefore, some new technologies, such as simple innovations in drug packaging could help implement effective and cost-effective therapies and provide sustainable support for the aged.<sup>20</sup>

## Data Sharing Statement

All data analyzed in this study are available from the corresponding author on reasonable request.

## Acknowledgments

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## Author Contributions

All authors contributed significantly to the work reported, either in the conception, study design, execution, acquisition, analysis, and/or interpretation of the data; took part in the drafting, revising, or critical reviewing of the article; gave final approval of the version to be published; agreed about the journal to which the article would be submitted; and agreed to be accountable for all aspects of the work.

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## Disclosure

The authors report no conflicts of interest in this work.

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