BACKGROUND AND OBJECTIVES: The use of written asthma action plans (WAAPs) has been associated with reduced asthma-related morbidity, but there are concerns about their complexity. We developed a health literacy–informed, pictogram- and photograph-based WAAP and examined whether providers who used it, with no training, would have better asthma counseling quality compared with those who used a standard plan.

METHODS: Physicians at 2 academic centers randomized to use a low-literacy or standard action plan (American Academy of Allergy, Asthma and Immunology) to counsel the hypothetical parent of a child with moderate persistent asthma (regimen: Flovent 110 μg 2 puffs twice daily, Singulair 5 mg daily, Albuterol 2 puffs every 4 hours as needed). Two blinded raters independently reviewed counseling transcriptions. Primary outcome measures: medication instructions presented with times of day (eg, morning and night vs number of times per day) and inhaler color; spacer use recommended; need for everyday medications, even when sick, addressed; and explicit symptoms used.

RESULTS: 119 providers were randomly assigned (61 low literacy, 58 standard). Providers who used the low-literacy plan were more likely to use times of day (eg, Flovent morning and night, 96.7% vs 51.7%, \( P < .001; \text{OR} = 27.5; 95\% \text{CI}, 6.1–123.4\)), recommend spacer use (eg, Albuterol, 83.6% vs 43.1%, \( P < .001; \text{OR} = 6.7; 95\% \text{CI}, 2.9–15.8\)), address need for daily medications when sick (93.4% vs 34.5%, \( P < .001; \text{OR} = 27.1; 95\% \text{CI}, 8.6–85.4\)), use explicit symptoms (eg, “ribs show when breathing,” 54.1% vs 3.4%, \( P < .001; \text{OR} = 33.0; 95\% \text{CI}, 7.4–147.5\)). Few mentioned inhaler color. Mean (SD) counseling time was similar (3.9 [2.5] vs 3.8 [2.6] minutes, \( P = .8\)).

CONCLUSIONS: Use of a low-literacy WAAP improves the quality of asthma counseling by helping providers target key issues by using recommended clear communication principles.

WHAT'S KNOWN ON THIS SUBJECT: Asthma action plan use is recommended to reduce asthma-related morbidity, but there are concerns about their effectiveness in low-literacy populations. Health literacy–informed approaches have been linked to improved patient outcomes but have not been well studied in child asthma.

WHAT THIS STUDY ADDS: A low-literacy, pictographic and photographic written asthma action plan may help providers target key issues in asthma management and use recommended principles of clear health communication, without the need for training and without increased time burden.
Low health literacy (HL) is likely to contribute to poor management of child asthma. Asthmatic children of parents with low HL are at risk for worse asthma-related outcomes, including greater asthma symptom severity and higher hospitalization rates. Use of HL-informed counseling strategies (eg, teach back, easy-to-read written materials) has been found to improve comprehension, disease management, and outcomes for various health conditions but has not been well studied for asthma. Low-literacy written materials used as part of counseling can offer providers a framework with which to counsel patients and their families, prompting them to focus on specific issues and supporting the use of plain language. Unfortunately, few low-literacy tools to improve asthma management exist. US asthma action plans are commonly written above a sixth-grade reading level, and often do not use a HL-informed approach to layout, graphics, and content. In addition, many plans must be filled in by hand, contributing to variability and errors in interpretation. One strategy that could help standardize the presentation of medication instructions and support provider use of HL principles is the use of a computer-generated, low-literacy asthma action plan. To date, few studies of HL-informed approaches to improve asthma management have been conducted.

We therefore sought to examine whether physicians who use a low-literacy, pictogram- and photograph-based WAAP would demonstrate higher-quality asthma counseling compared with those who use a standard plan requiring individual provider completion, and whether differences exist by factors previously found to affect asthma care, including physician training level, asthma care experience, and gender. We hypothesized that those who used the low-literacy WAAP would be more likely to address key asthma management issues by using clear communication principles and that overall the benefit of the low-literacy WAAP would be similar across domains regardless of physician characteristics.

METHODS
Participants, Recruitment, and Randomization
This was a randomized controlled study to examine whether use of a low-literacy WAAP can improve provider asthma counseling, as assessed with a hypothetical scenario involving a parent of a child with persistent asthma. The institutional review boards of New York University (NYU) and Northwestern and the Research Review Committee of Bellevue Hospital approved this study.

Study subjects were recruited from NYU and Northwestern between June 17, 2012 and October 9, 2012. A convenience sample of physicians was assessed to determine eligibility. We included pediatricians who care for children with asthma (ie, residents [minimum end of intern year], fellows, attendings). Written informed consent was obtained. Research assistants (RAs) emphasized that participation was voluntary and that collected information would not be shared with supervisors.

Enrolled providers were randomly assigned to receive the low-literacy WAAP (Fig 1) or a standard WAAP endorsed by the American Academy of Allergy, Asthma and Immunology (AAAAI). Randomization was performed with sealed envelopes blocked by physician training level (first, second, third year, fellow or attending). Trained RAs delivered the intervention after conducting the background interview.

Intervention Group: Low-Literacy WAAP
Table 1 compares the features of the low-literacy and standard WAAPs. The low-literacy WAAP is an extension of the HELPix (Health Education and Literacy for Parents) pictogram-based medication instruction sheet intervention. It was developed through a collaborative process that included parents, pediatricians, asthma specialists, nurses, health educators, and health literacy experts, involving 1:1 interviews and group discussions. Feedback was purposively sought from parents with low literacy who had children with moderate to severe asthma.

Control Group: Standard WAAP
Providers randomly assigned to receive the standard WAAP were provided with the AAAAI action plan; the AAAAI plan is among the better
plans of those that are nationally available with respect to adherence to HL-informed principles such as layout and content. Medication information is filled out by a provider within a table format.9

Assessments

Trained RAs conducted brief interviews with each health care provider. RAs and providers were blinded to randomization status until just before the provider was asked to use either the low-literacy or standard WAAP to counsel a parent of an asthmatic patient by using a hypothetical scenario. Because providers used the action plan to counsel the RA, it was not possible to blind either group once the counseling portion of the assessment began. No participant incentives were provided.

Asthma Counseling Assessment

Providers were asked to use the assigned WAAP to counsel a hypothetical parent of a child with moderate persistent asthma on the following regimen: Singulair (montelukast sodium) 5 mg once a day, Flovent (fluticasone propionate) 110 μg/actuation 2 puffs twice a day, and Albuterol 90 μg/actuation 2 puffs every 4 hours as needed. Providers randomly assigned to receive the AAAAI plan were first asked to fill out the blank form with the child’s medication information. Providers were given the opportunity to take as much time as they needed to look at their assigned plan and demonstrate counseling. Providers were instructed, “Please pretend that I am the parent of a child who has recently been diagnosed with asthma. Use the action plan as you normally would for counseling, to teach me how to manage my child’s asthma on a symptom free day, when my child has some symptoms, as well as when my child has severe asthma symptoms.” Counseling was audio recorded. Audio recordings were transcribed by 1 of 3 trained RAs blinded to intervention status, with verification of accurate transcription by a second RA.

Use of Clear Communication Principles

Primary outcome measures focused on the use of clear communication principles during counseling within 4 key domains: presentation of medication instructions based on times of day (ie, “morning” and “night”; preferable to number of times/day, eg, “2×/day”) and inhaler colors mentioned; spacer use (inhaler medications); need for everyday medications, even when sick, mentioned generally, and specific mention of Flovent and Singulair in yellow zone; and explicit words used to present symptoms of serious exacerbation (eg, “ribs show when breathing” preferred over “difficulty breathing”).

Selection of the characteristics examined within each audio-recorded counseling session was guided by review of the literature on aspects considered to be important from clinical and HL perspectives.1
medication instructions:

TABLE 1 Comparison of Features of the Low-Literacy Pictogram- and Photograph-Based Action Plan and Standard Action Plan

<table>
<thead>
<tr>
<th>Overall structure</th>
<th>Low-Literacy Action Plan Features</th>
<th>Supporting Evidence</th>
<th>Standard Action Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Three color zones used to divide information about everyday care (green section) from information about when the child is starting to get sick (yellow; rescue medicine needed) and when the child is very sick (red; emergency help needed).</td>
<td>Evidence suggests that symptom-based action plans are superior to peak flow–based plans with respect to prevention of acute care visits.⁴,⁷,⁸</td>
<td>Symptom-based information for asthma management and areas where providers can fill in peak flow–based information, a typical feature of US action plans.⁹</td>
</tr>
<tr>
<td>Presentation of medication instructions: Misunderstanding of asthma medication instructions is a contributor to the high rate of parent and patient nonadherence to prescribed asthma medication regimens,²⁴ misunderstandings relate to timing and frequency of medications, as well as mix-ups between which inhaler to take for emergencies and which inhaler is for everyday use.¹¹</td>
<td>Use of medication instructions relating to particular times per day (eg, morning, noon, evening, bedtime) has been found to improve patient understanding, especially with complex regimens.⁴⁷,⁴⁸ and is part of new evidence-based medication labeling standards issued by the US Pharmacopoeia.⁴¹</td>
<td>No guidance for provider given about how to present times of day; most commonly, providers presented instructions in times per day (eg, “2×/day”).</td>
<td></td>
</tr>
<tr>
<td>Times of day used (eg, “morning” and “night”).</td>
<td>Morning and night pictograms emphasize times of day.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shading used to “chunk,” or cluster, information about morning and night medication regimens.</td>
<td>Incorporation of pictograms in medication instructions has been found to improve medication self-management.⁴²</td>
<td>No morning and night pictograms.</td>
</tr>
<tr>
<td></td>
<td>Photographs of inhalers included to help parents differentiate between their everyday and rescue inhalers; color of each inhaler evident from photographs (Flovent, orange; Albuterol, blue).</td>
<td>Chunking of information helps cluster similar information, which is easier for the brain to process.⁴³</td>
<td>No shading used to chunk information about morning and night regimens.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use of color is a strategy used to help support understanding of key concepts; in this case, presenting inhaler color provides valuable information to help parents act on medication instructions.⁴⁵</td>
<td>No colors of inhalers indicated. Providers can choose to write in inhaler colors.</td>
</tr>
</tbody>
</table>

Additional Counseling-Related Outcomes Assessed

Secondary outcomes included counseling duration and provider plan preference. After the audio recording, providers were shown the action plan they were not randomly assigned to and asked, “Which of these two asthma action plans would you prefer to use when counseling parents of children with asthma?”

Provider Sociodemographics and Asthma-Related Experience

We assessed provider sociodemographic characteristics, including age, gender, country of birth, race and ethnicity before provider counseling. Provider training level was categorized as resident year 1, 2, 3, and fellow or attending.

Provider asthma-related experience was assessed via a structured questionnaire. Frequency of providing clinical care to children with asthma was assessed with the question, “How often do you provide clinical care to children with asthma?” (often, sometimes, or rarely). Previous use of WAAPs was assessed with 2 questions: “How often do you counsel using a written asthma action plan?” (often, sometimes, rarely, or never), and “How confident are you that you can explain an asthma action plan to parents so that they understand how to correctly manage their child’s asthma?” (confident, somewhat confident, slightly confident, or not confident).
Statistical Analysis

Data were analyzed in SPSS 20.0 (IBM SPSS Statistics, IBM Corporation). For all analyses, a 2-tailed P value of ≤ 0.05 was considered to be statistically significant. \( \chi^2 \) and logistic regression were performed to examine outcomes by randomization status; subgroup analyses were conducted to examine differences by physician training level (resident vs fellow or attending), how often clinical care was provided to asthmatic children (often vs sometimes/rarely), and gender. Interrater reliability was high (\( \kappa \) range 0.76–0.98, median 0.92), based on agreement or disagreement for scoring of each action plan characteristic being present or absent. A third reviewer (H.S.Y.) provided an independent review in cases of discordant rating, with majority rule used in cases of discordance.

Sample Size Estimation

Sample size estimates were based on the outcome of spacer use. Spacer use is associated with better asthma outcomes,12,45,46 and counseling about spacer use is considered the standard of care in asthma management.1 Based on previously collected pilot data from our clinic, we estimated a baseline rate of provider inclusion of spacer use as part of action plan counseling as being ~50%. We calculated a sample size of ~120 parents to achieve 80% power (2-sided \( \alpha = 0.05 \)) to detect an increase in rate to 75% to 80% in the group receiving the low-literacy action plan compared with the group using the standard plan.

Results

In total, 119 providers were enrolled (61 low-literacy, 58 standard WAAP) (Fig 2). Across groups, providers were similar with respect to age, gender, race, ethnicity, and previous asthma-related experience (Table 2). Providers who used the low-literacy plan were more likely to recommend a time of day for taking
daily medications rather than using number of times per day (eg, Flovent, 96.7% vs 51.7%, \(P < .001\); odds ratio [OR] = 27.5; 95% confidence interval [CI], 6.1–123.4) (Table 3).

More than 80% of providers who used the low-literacy plan mentioned spacers with Flovent and Albuterol; fewer than half who used the standard plan did so (\(P < .001\)) (Table 3).

Providers who used the low-literacy plan were more likely to reinforce the need for everyday medications, even when the child is sick (93.4% vs 34.5%, \(P < .001\); OR = 27.1; 95% CI, 8.6–85.4), including being more likely to specify medication names.

Providers who used the low-literacy plan were more likely to use explicit respiratory signs and symptoms such as “ribs show when breathing” (54.1% vs 3.4%, \(P < .001\); OR = 33.0; 95% CI, 7.4–147.5) (Table 3).

The mean (SD) amount of time used for counseling was similar in the 2 groups (3.9 [2.5] vs 3.8 [2.6] minutes, \(P = .8\)). More than 90% of providers in both groups preferred the low-literacy plan (96.7% vs 93.1%, \(P = .6\)).

**Subgroup Analyses**

No consistent patterns were found with action plan impacts by provider characteristics, although some isolated examples were present. Presentation of medication frequency improved to a greater extent for fellows and attending physicians compared with residents because of a smaller number of standard plan fellows and attending physicians using the low-literacy strategy. For example, recommending Flovent in the morning and night increased more for fellows and attending physicians (100% vs 36.4%, \(P < .001\)) than residents (94.6% vs 61.1%, \(P = .002\)). There was a greater increase in reinforcement of the need to give everyday medications, even when sick, for providers with less asthma care experience (96.0% vs 22.7%, \(P < .001\)) compared with providers with more experience (94.3% vs 41.7%, \(P < .001\)). Presentation of symptoms of serious exacerbations increased to a greater degree for fellows and attending physicians than for residents. For example, mentioning ribs showing increased more for fellows and attending physicians (70.8% vs 4.5%, \(P < .001\)) than for residents (43.2% vs 2.8%, \(P < .001\)). There were no differences by gender.

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**TABLE 1 Continued**

<table>
<thead>
<tr>
<th>Features</th>
<th>Supporting Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion of predominantly explicit symptoms along the left column of the action plan (eg, “ribs show when breathing,” “can’t stop coughing,” “neck pulls in”).</td>
<td>Presentation of explicit symptoms is helpful in providing clarity about what parents should look for, making the instructions more actionable.45</td>
</tr>
<tr>
<td>Symptoms presented 1 at a time in bullet format.</td>
<td>Symptoms presented 1 at a time are easier to read than when unrelated symptoms are clustered together.22</td>
</tr>
</tbody>
</table>

![Study enrollment](fig2.png)

**FIGURE 2**

Study enrollment.

126 physicians assessed for eligibility

7 enrolled but left before randomization due to time constraints

119 underwent randomization

61 allocated to low-literacy action plan

58 allocated to standard action plan

61 included in analysis

58 included in analysis

Downloaded from www.aappublications.org/news by guest on January 7, 2021
DISCUSSION

This study examines whether a computer-generated HL-informed WAAP, used without previous training, can improve physician ability to counsel about pediatric asthma management compared with a standard WAAP requiring physician completion. We found that physicians who used the low-literacy WAAP to counsel a hypothetical parent of a child with persistent asthma were more likely to use clear communication principles than those who used the standard plan and that, overall, physicians preferred the low-literacy plan.

Although low-literacy written materials are typically thought to directly benefit families by giving them access to easy-to-understand information, this study demonstrates how low-literacy materials can also improve the quality of physician counseling by giving providers a framework for counseling that prompts them to address key issues known to be difficult for families to grasp. Written materials can also be designed to support provider use of evidence-based communication strategies known to maximize learning, including partitioning, or grouping information into digestible chunks, as well as modeling specific plain language wording to explain confusing medical concepts.

Guided by the format used to portray medication instructions and the associated pictograms on the low-literacy WAAP, nearly all providers randomly assigned to receive the low-literacy WAAP gave instructions for when to take daily medications by using time of day (eg, “morning and night”) instead of less specific instructions, such as “twice a day.” A majority of providers who used the low-literacy plan recommended spacer use and reinforced the importance of continuing daily medications even when sick. Modeling of specific wording led providers who used the low-literacy plan to use explicit words to describe respiratory signs and symptoms. These findings demonstrate how a thoughtful redesign of WAAPs can be used to systematically influence the content and style of provider counseling. Additionally, our subgroup analyses did not reveal robust differences by provider characteristics, suggesting that the benefit of the low-literacy plan is likely to be seen regardless of physician training level, asthma care experience, or gender.

Interestingly, although the low-literacy WAAP we developed included photographs of the inhalers as a strategy to address the issue of parent mix-up of everyday and rescue medications, few providers

### Table 2: Study Population Characteristics by Randomization Group

<table>
<thead>
<tr>
<th>Provider characteristics</th>
<th>Low-Literacy Action Plan (n = 61, n (%)</th>
<th>Standard Action Plan (n = 58, n (%))</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y&lt;sup&gt;a&lt;/sup&gt;</td>
<td>≤30: 38 (63.3) 35 (60.3) .8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31–40: 10 (16.7) 12 (20.7)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>41–50: 7 (11.7) 8 (13.8)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>≥51: 5 (8.3) 3 (5.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender, female</td>
<td>45 (75.0) 49 (84.5) .3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country of birth: US, n (%)</td>
<td>53 (86.9) 51 (87.9) 1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race or ethnicity, n (%)&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>4 (6.7) 4 (6.9) .9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>42 (70.0) 42 (72.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>2 (3.3) 3 (5.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>10 (16.7) 8 (13.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>2 (3.3) 1 (1.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician training category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident year 1</td>
<td>10 (16.4) 9 (15.5) .9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident year 2</td>
<td>16 (26.2) 14 (24.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident year 3</td>
<td>11 (18.0) 13 (22.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fellow or attending</td>
<td>24 (39.3) 22 (37.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYU</td>
<td>32 (52.5) 32 (55.2) .9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northwestern</td>
<td>29 (47.5) 26 (44.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma-related experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How often provide clinical care to children with asthma&lt;sup&gt;b&lt;/sup&gt;</td>
<td>35 (58.3) 36 (62.1) .3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Often</td>
<td>24 (40.0) 18 (31.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>1 (1.7) 4 (6.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ever used a written asthma action plan to counsel</td>
<td>57 (93.4) 54 (93.1) 1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How often do you counsel using a written asthma action plan</td>
<td>20 (32.9) 12 (20.7) .5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Often</td>
<td>23 (37.7) 28 (48.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>13 (21.3) 14 (24.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely</td>
<td>5 (8.2) 4 (6.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confidence in ability to explain written asthma action plan&lt;sup&gt;c&lt;/sup&gt;</td>
<td>19 (32.2) 19 (32.8) .8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confident</td>
<td>28 (47.5) 24 (41.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat confident</td>
<td>10 (16.9) 11 (19.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slightly confident</td>
<td>2 (3.4) 4 (6.9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> No study subjects >60 y of age.
<sup>b</sup> Missing for 1 study subject.
<sup>c</sup> Missing for 2 study subjects.
mentioned inhaler color as one way to distinguish between inhaler types. This may be because providers think that the color is already evident in the photographs. Providers may also think that because generic albuterol comes in different colors, the color of the inhaler shown on the action plan may not match the color of the inhaler the parent receives from the pharmacy. Additional study is needed to examine what strategies would be most effective for addressing the problem of daily and rescue inhaler mix-ups by parents. A systems approach to this issue could include industry-wide change such that all rescue medications are consistently 1 color and maintenance medications another color, an approach that has been used in countries outside the United States.11,48,49

The need for provider training has been found to be a barrier to implementation of HL-informed interventions;50 this study demonstrates that improvements in provider counseling quality can occur simply with improved written materials that serve as a scaffolding for structured counseling. Notably, we also found no difference in counseling duration with the low-literacy WAAP, supporting the feasibility of implementing our pictogram-based WAAP. Additionally, provider acceptability was high.

Currently, there exists a wide range of asthma action plans; no standard universal plan format is available.25 Implementing the low-literacy computer-generated WAAP could help reduce variability in the manner in which instructions are provided. A move to having a nationally available, evidence-based low-literacy asthma action plan could help improve parent and patient understanding, adherence, and, ultimately, asthma outcomes.

This study has several limitations. This was not a study of real-world practice; a hypothetical scenario was used. Use of the hypothetical scenario probably limited the interactive conversations that might typically occur between parents and providers; a study is in progress involving actual medication regimens. We compared our low-literacy plan with a single action plan, not with the full range of plans available. However, because there is no single standard national plan, we chose what we considered to be one of the better plans of those that were nationally available. We also did not examine the time it would take for a provider to fill in patient regimen information to generate patient-specific forms using a computer application, although we

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**TABLE 3 Provider Counseling Strategies Used by Randomization Group**

<table>
<thead>
<tr>
<th></th>
<th>Low-Literacy Action Plan (n = 61), n (%)</th>
<th>Standard Action Plan (n = 58), n (%)</th>
<th>P-value</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presentation of medication instructions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How medication frequency described</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flovent: morning and night&lt;sup&gt;b&lt;/sup&gt;</td>
<td>59 (96.7)</td>
<td>30 (51.7)</td>
<td>&lt;.001</td>
<td>27.5</td>
<td>6.1–123.4</td>
</tr>
<tr>
<td>Flovent: twice a day, 2×/day</td>
<td>16 (26.2)</td>
<td>45 (77.6)</td>
<td>&lt;.001</td>
<td>0.1</td>
<td>0.04–0.2</td>
</tr>
<tr>
<td>Singulair: every night&lt;sup&gt;b&lt;/sup&gt;</td>
<td>54 (88.5)</td>
<td>26 (44.8)</td>
<td>&lt;.001</td>
<td>9.5</td>
<td>3.7–24.4</td>
</tr>
<tr>
<td>Singulair: once a day, 1×/day</td>
<td>7 (11.5)</td>
<td>32 (55.2)</td>
<td>&lt;.001</td>
<td>0.1</td>
<td>0.04–0.3</td>
</tr>
<tr>
<td>Color of inhaler described</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flovent (orange)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10 (16.4)</td>
<td>5 (8.6)</td>
<td>.3</td>
<td>2.1</td>
<td>0.7–6.5</td>
</tr>
<tr>
<td>Albuterol (blue)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10 (16.4)</td>
<td>1 (1.7)</td>
<td>.01</td>
<td>11.2</td>
<td>1.4–90.4</td>
</tr>
<tr>
<td><strong>Presentation of spacer information</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacer use with Flovent&lt;sup&gt;b&lt;/sup&gt;</td>
<td>50 (82.0)</td>
<td>24 (41.4)</td>
<td>&lt;.001</td>
<td>6.4</td>
<td>2.8–14.9</td>
</tr>
<tr>
<td>Spacer use with Albuterol&lt;sup&gt;b&lt;/sup&gt;</td>
<td>51 (83.6)</td>
<td>25 (43.1)</td>
<td>&lt;.001</td>
<td>6.7</td>
<td>2.9–15.8</td>
</tr>
<tr>
<td><strong>Reinforcement of need for everyday preventive medications, even when sick</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentions need to continue to give every day medicines&lt;sup&gt;b&lt;/sup&gt;</td>
<td>57 (93.4)</td>
<td>20 (34.5)</td>
<td>&lt;.001</td>
<td>27.1</td>
<td>8.6–85.4</td>
</tr>
<tr>
<td>Specifically names Flovent&lt;sup&gt;b&lt;/sup&gt;</td>
<td>35 (57.4)</td>
<td>11 (19.0)</td>
<td>&lt;.001</td>
<td>5.8</td>
<td>2.5–13.2</td>
</tr>
<tr>
<td>Specifically names Singulair&lt;sup&gt;b&lt;/sup&gt;</td>
<td>32 (52.5)</td>
<td>12 (20.7)</td>
<td>.01</td>
<td>4.2</td>
<td>1.9–9.5</td>
</tr>
<tr>
<td><strong>Presentation of symptoms of serious exacerbation (red zone)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathing fast&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31 (50.8)</td>
<td>5 (8.6)</td>
<td>&lt;.001</td>
<td>11.0</td>
<td>3.9–31.2</td>
</tr>
<tr>
<td>Breathing hard&lt;sup&gt;b&lt;/sup&gt;</td>
<td>24 (39.3)</td>
<td>2 (3.4)</td>
<td>&lt;.001</td>
<td>18.2</td>
<td>4.0–81.5</td>
</tr>
<tr>
<td>Difficulty breathing</td>
<td>25 (41.0)</td>
<td>36 (62.1)</td>
<td>.03</td>
<td>0.4</td>
<td>0.2–0.9</td>
</tr>
<tr>
<td>Cannot stop coughing&lt;sup&gt;b&lt;/sup&gt;</td>
<td>28 (45.9)</td>
<td>1 (1.7)</td>
<td>&lt;.001</td>
<td>48.4</td>
<td>6.3–372.0</td>
</tr>
<tr>
<td>Coughing</td>
<td>16 (26.2)</td>
<td>19 (32.8)</td>
<td>.6</td>
<td>0.7</td>
<td>0.3–1.6</td>
</tr>
<tr>
<td>Neck pulls in&lt;sup&gt;b&lt;/sup&gt;</td>
<td>29 (47.5)</td>
<td>1 (1.7)</td>
<td>&lt;.001</td>
<td>51.7</td>
<td>6.7–397.2</td>
</tr>
<tr>
<td>Ribs show when breathing&lt;sup&gt;b&lt;/sup&gt;</td>
<td>33 (54.1)</td>
<td>2 (3.4)</td>
<td>&lt;.001</td>
<td>33.0</td>
<td>7.4–147.5</td>
</tr>
<tr>
<td>Trouble talking&lt;sup&gt;b&lt;/sup&gt;</td>
<td>36 (59.0)</td>
<td>20 (34.5)</td>
<td>.01</td>
<td>2.7</td>
<td>1.3–5.8</td>
</tr>
<tr>
<td>Trouble walking</td>
<td>18 (29.5)</td>
<td>15 (25.9)</td>
<td>.8</td>
<td>1.2</td>
<td>0.5–2.7</td>
</tr>
<tr>
<td>Wheezing</td>
<td>3 (4.9)</td>
<td>17 (28.3)</td>
<td>&lt;.001</td>
<td>0.1</td>
<td>0.03–0.5</td>
</tr>
</tbody>
</table>

<sup>a</sup> x<sup>2</sup>.

<sup>b</sup> Aspects specifically supported by the low-literacy, pictographic action plan.
CONCLUSIONS

We found that our low-literacy WAAP improved the quality of asthma counseling by providers by helping them highlight key aspects of asthma management previously found to be problematic for families and promoting the use of plain language principles. Additional studies are needed to determine whether improved counseling, using the low-literacy action plan, will contribute to improved parent and patient understanding, adherence, and child asthma outcomes.

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ABBREVIATIONS

AAAAI: American Academy of Allergy, Asthma and Immunology
CI: confidence interval
HL: health literacy
NYU: New York University
OR: odds ratio
RA: research assistant
WAAP: written asthma action plan

content; Dr Egan participated in the conceptualization and design of the study, participated in the acquisition of data, assisted in the analysis and interpretation of data, and provided critical revision of the manuscript for important intellectual content; Ms Sanchez participated in the design of the study, participated in the acquisition of data, assisted in the analysis and interpretation of data, and assisted in the drafting of the manuscript; Mr Warren participated in the design of the study, participated in the acquisition of data, assisted in the analysis and interpretation of data, and assisted in the revision of the manuscript; Ms Encalada participated in the design of the study, assisted in the analysis and interpretation of data, and assisted in the revision of the manuscript; and all authors approved the final manuscript as submitted.

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expect that if the generation of action plans is linked to the electronic medical record, such information could easily be prepopulated into the form, minimizing provider time burden. Our team has previously used this model for the generation of low-literacy medication instruction sheets for medications prescribed in the outpatient setting. Notably, as is typical for many action plans, the AAAAI requires providers to fill in a patient’s medication regimen. For this study, we did not examine the implications of prepopulating the AAAAI action plan with times of day for medication administration and explicit symptoms. In addition, the low-literacy action plan was studied as a whole; additional study would be needed to examine which aspects of the action plan were most important. The low-literacy action plan was also studied as a printed handout; additional enhancement of the tool is in progress with the development of a Web application to generate the personalized action plan, which includes links to low-literacy video demonstrating how to administer the child’s medication doses with the inhaler and spacer. Video links showing specific symptoms could also be beneficial; currently the limited space on the 1-page action plan does not accommodate visuals of each listed symptom. Finally, this study involved a convenience sample of physicians at clinical sites affiliated with 2 academic centers that serve low-income populations, and therefore our findings may not be generalizable. In particular, we did not include nurses or health educators in our study, and given the growing importance of those groups in action plan counseling, it would be useful to understand whether there are any differences when the low-literacy plans are used by other health care providers.
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