The Interpreter as Cultural Educator of Residents

Improving Communication for Latino Parents

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Objective: To determine whether augmentation of the Spanish interpreter’s role to include cultural education of residents can improve the satisfaction of Latino patients.

Design: We assessed parent satisfaction during 4 sequential 2-month periods between June 1, 2004, and February 11, 2005, using different interpretation methods: telephone interpretation (n=91 patient encounters), trained in-person interpretation (n=49), in-person interpretation with cultural education of residents (n=65), and postprogram telephone interpretation (n=45).

Setting: General pediatric practice at a large teaching hospital.

Participants: A total of 250 Spanish-speaking parents who were limited in English proficiency.

Interventions: The cultural education program included 3 brief preclinic conferences taught by an interpreter and one-on-one teaching of residents about language and cultural issues after each clinical encounter.

Main Outcome Measures: Parent satisfaction was assessed using 8 questions that have previously been validated in Spanish. Lower scores indicated more satisfaction.

Results: Because they were limited in English proficiency, our Spanish-speaking patients were significantly more satisfied when an in-person interpreter was used compared with a telephone interpreter (mean total satisfaction score of 14.5 [in-person] vs 17.4 [telephone]; P=.006) but were even more satisfied when the interpreter educated residents in cultural and language issues (mean, 11.5 [in-person with education] vs 17.4 [telephone]; P<.001).

Conclusion: Although use of an in-person interpreter can increase Latino parents’ satisfaction, a program using an interpreter to educate residents in cultural and language issues can increase satisfaction further.

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Communication between patient and physician is a fundamental aspect of patient care, but unfortunately in the United States, physicians often do not share the same language and culture as their patients, making communication difficult. Latino individuals are currently the largest racial/ethnic minority group of US children, and language issues are one of the major barriers to accessing health care encountered by such children. Communication gaps due to language differences compromise medical care in many different ways. Studies have documented that language barriers lead to a decreased likelihood of follow-up appointments being made after a visit to an emergency department; a higher rate of resource utilization for diagnostic tests; less satisfaction with medical care when seen in the emergency department or by primary care physicians; a decreased likelihood of having had a health care visit, mental health visit, or influenza vaccination; decreased explanation of adverse effects; decreased compliance with medications; an increased incidence of medical errors during hospitalizations; and a decreased likelihood of receiving all preventive health visits in the first year of life. The ability for physicians to communicate effectively either in Spanish or with the use of interpreters is an important desire expressed by Latino patients. Case studies demonstrate that in addition to addressing language barriers, it is important to understand normative cultural values, folk illnesses, and parent and patient beliefs in pediatric health care. Pachter describes a system of culturally sensitive health care that respects ethnic and cultural values along with linguistic considerations to enhance the quality of the interaction between the patient and the health care system. Similarly, Kleinman et al suggest that the negotiation of a shared explanatory
model between patient and physician may be a crucial step in developing trust, encouraging adherence to medical regimens, and improving patient satisfaction.

Studies demonstrate that bilingual health care professionals and trained professional interpreters result in the best patient satisfaction, outcomes, and quality of care compared with untrained or ad hoc interpreters. For example, Mazor et al taught pediatric emergency department physicians a 10-week intensive medical Spanish course and demonstrated that at the end of the course physicians were able to care for Spanish-speaking patients without the use of interpreters more frequently than before the course. Furthermore, families had greater satisfaction with the care they received. Unfortunately, teaching physicians Spanish can lead to problems with false fluency because physicians are less likely to use interpreters and instead rely on their own inadequate Spanish-speaking skills. Medical interpreters are crucial to effective communication between patients limited in English proficiency (LEP) and health care professionals, yet Spanish-speaking Latino persons are less satisfied than their English-proficient counterparts even when interpreters are used. When language barriers are present, cultural barriers are present as well. Therefore, the medical system needs further interventions beyond that of the trained, professional interpreter to help bridge cultural barriers with LEP patients.

Effectively using interpreters to communicate with LEP patients is not traditionally part of medical training. In a study of pediatric residents, Burbano O’Leary et al found that non–Spanish-fluent residents rarely used professional interpreters.

Common methods to help overcome language barriers include the use of a telephone interpreter, an in-person interpreter, or an ad hoc interpreter (untrained individuals such as a family member, friend, nonclinical health care worker, or stranger from the waiting room). Studies disagree on whether telephone interpretation or trained in-person interpretation is best; significant shortcomings exist with both methods of interpretation. We sought to examine the effects of a novel method using an in-person interpreter as a cultural educator of residents.

The goal of the study was to evaluate an intervention aimed at improving communication between pediatric residents and Spanish-speaking parents who are LEP. We hypothesized that by understanding Latino cultural values and home remedies, learning to use interpreters, and mastering Spanish phrases that helped establish rapport, pediatric resident physicians would be able to communicate more effectively with their Latino patients, resulting in improved satisfaction among the patients.

**METHODS**

**STUDY DESIGN**

The study was conducted in a general pediatric practice of a large teaching hospital that serves a predominantly Medicaid population and has approximately 22,000 visits per year. The study was approved by the Yale University School of Medicine’s institutional review board. The study involved 4 sequential 2-month phases using different interpretation methods: telephone interpretation (phase A), in-person interpretation (phase B), in-person interpretation with resident education (phase C), and postprogram telephone interpretation (phase D). The study began on June 1, 2004, and ended February 11, 2005. The same individual (J.O.) served as in-person interpreter (phase B) and resident educator (phase C).

Eligible study participants included all parents who were Spanish-speaking, who were LEP, and whose children were being seen for either a well or sick visit by a pediatric resident who was not fluent in Spanish. We defined LEP as self-rated ability to speak English as fair or poor. The age range of the children was 2 days to 12 years; adolescent patients are seen in a separate clinic. Triage nurses who were blinded to the purpose of the study identified parents who needed an interpreter; a nurse evaluated parents by asking basic questions about the child. If the mother could not understand or respond properly, an interpreter was called. In the cases in which the mother spoke some English, she was asked if she wished to have an interpreter. After patient visits, a bilingual research assistant (E.E.G.) approached every LEP, Spanish-speaking parent who used an interpreter (telephone or in person). The research assistant presented the study as one of parent satisfaction in the clinic and did not mention that it was a study of interpretation method. After written informed consent was obtained, a patient satisfaction questionnaire was administered orally in Spanish by the research assistant.

One of the 50 pediatric residents at our hospital described herself as a native Spanish speaker and was excluded from the study. The remaining 49 residents participated in the study and completed written questionnaires describing their experiences with Spanish interpreters before and after the program. Each resident in our program has a weekly continuity clinic in our hospital; thus, all 49 residents in the program participated in the study. No resident was involved with more than 3 of the encounters in this study.

Both the telephone and in-person interpreters at the study hospital receive more than 60 hours of extensive training in proper interpreting technique, professional ethics, interpreter roles, medical terms, and cultural brokerage. Interpreter training specifically emphasizes the use of appropriate interventions to clarify possible misunderstandings caused by educational or cultural issues. Although the in-person interpreter in this study was from a South American background, she had extensive experience with many Latino groups in the United States. Telephone interpretation was conducted with telephones that were placed in patient rooms at the time of the visit, and interpretation was performed with speaker telephones.

**INTERVENTION**

The trained in-person interpreter served as a cultural educator for a 2-month period. The teaching occurred in (1) 30-minute group sessions during preclinic seminars in a conference room and (2) individual sessions related to specific clinical encounters with patients.

The goals of the group didactic sessions were to introduce Latino cultural values and home remedies that could contribute to a physician’s history taking, to optimize the use of interpreters in improving communication, to teach residents a few Spanish expressions to help establish rapport with Spanish-speaking patients, and to teach techniques for using interpreters.

The individual sessions between interpreter and resident occurred at the end of a patient visit when the patient was not present or when the resident stepped out of the room. The interpreter reviewed language or cultural issues that emerged during the visit. For example, in Latino culture, parents commonly place bracelets with amulets on a baby’s wrist to ward
off the “evil eye” or simply to protect the child. The interpreter observed that residents frequently cautioned parents against using jewelry on infants, and once even removed the bracelet from a child’s wrist, causing embarrassment and offense. Once the residents understood the traditional use of these amulets, their teaching with parents was modified. Instead of cautioning parents to remove the amulets, they asked parents to check if the bracelets were cutting off circulation or suggested that they secure the amulets to clothing, thus ensuring safety while respecting the parents’ beliefs.

Furthermore, the interpreter reminded the residents to introduce parents because the initial greeting is particularly important in Latino culture. The resident educator taught the residents to say to their patients, “Hello, my name is Dr ___” in Spanish to demonstrate an attempt to communicate in the patient’s native language. In addition, the resident educator taught the residents proper technique when using interpreters. For example, she reminded the residents to maintain eye contact with the patient and/or parent and to avoid speaking directly to the interpreter. With each topic covered in both group sessions and individual teaching, the interpreter was careful to point out differences in customs from each national group. Despite general cultural commonalities among the Latino population as a whole, important variations in cultural practices also exist among Latino individuals from various countries.

MAIN OUTCOME MEASURES

Parent satisfaction was measured using a patient satisfaction instrument that has been validated in both Spanish and English. The instrument uses a 5-point Likert scale (with 1 meaning excellent and 5 meaning poor) for each of 8 questions about the respondent’s satisfaction with the physician. These 8 questions are given in Table 1. The range of total satisfaction scores was 8 to 40, with 8 indicating excellent.

Residents completed questionnaires before and after the program about their experiences with treating LEP, Spanish-speaking patients in the clinic. The questionnaires asked for the resident’s self-reported race/ethnicity. In addition, using a 5-point Likert scale, residents were asked to rank their ability to speak Spanish, to take care of LEP, Spanish-speaking patients, and to use telephone interpreters or in-person interpreters. Residents were asked how often they used interpreters, and they were asked to rank a list of potential benefits of an interpreter providing cultural education.

STATISTICAL ANALYSIS

Analyses were performed using SAS statistical software, version 8.02 (SAS Institute Inc, Cary, NC). We present mean scores of satisfaction for each question and total summed scores in all 4 interpretation groups. To take into account that the satisfaction scores are nonparametric, we used the Kruskal-Wallis test to compare the scores among groups. To adjust for multiple comparisons, we applied the Bonferroni correction.

RESULTS

PARENT SATISFACTION

Of 460 parents approached, 83 (18.0%) were ineligible because their health care professionals for the visits were nurse practitioners or medical students, the families were in the clinic for nurse encounters only, or the parents had already participated in the study. A total of 250 (66.3%) of the 377 eligible parents participated in the study, and the proportion who participated in the study was similar in the 4 phases. Ninety-one LEP, Spanish-speaking parents were enrolled in the telephone interpretation phase (A), 49 in the in-person interpretation phase (B), 65 during in-person interpretation with cultural education of residents (C), and 45 in the telephone interpretation phase that followed the interpretation with cultural education (D). More parents were enrolled in phase A, since it was possible to have 2 simultaneous telephone interpretations because multiple telephone interpreters were available, whereas only 1 in-person interpreter was present.

The mean age of the children was 27.9 months, and 50.3% were female. There were no statistically significant differences among the 4 groups with respect to the child’s age or sex. The most common countries of origin of the LEP, Spanish-speaking parents were Mexico (44.4%), Puerto Rico (15.7%), Ecuador (15.7%), Guatemala (8.5%), Peru (4.8%), and Colombia (3.2%). The remaining 8.1% were from Chile, El Salvador, the Dominican Republic, Argentina, Cuba, the United States (excluding Puerto Rico), Honduras, and Nicaragua. There were no statistically significant differences among patients in the 4 phases of the study with respect to the country of origin. During the telephone interpretation phases before and after the cultural education of residents, a significantly lower proportion of patients was seen by first-year residents (P < .001). First-year residents saw 14 patients (15.4%) in the initial telephone interpretation phase, 19 patients (38.8%) in the in-person interpretation phase, 27 patients (41.5%) in the cultural education of residents phase, and 10 patients (22.2%) in the postprogram telephone interpretation phase. No significant variability was found in the Spanish-speaking ability of the residents across the phases.

Table 1. Patient Satisfaction Questionnaire*

<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>How was the doctor at showing concern for you?</td>
<td>1</td>
</tr>
<tr>
<td>How was the doctor at treating you with respect?</td>
<td>1</td>
</tr>
<tr>
<td>How was the doctor at being friendly to you?</td>
<td>1</td>
</tr>
<tr>
<td>How was the examiner at using words that you could understand, instead of confusing medical words?</td>
<td>1</td>
</tr>
<tr>
<td>How was the doctor at being friendly to you?</td>
<td>1</td>
</tr>
<tr>
<td>How was the doctor at spending enough time with you?</td>
<td>1</td>
</tr>
<tr>
<td>How was the doctor at treating you with respect?</td>
<td>1</td>
</tr>
<tr>
<td>How was the doctor at showing concern for you as a person?</td>
<td>1</td>
</tr>
<tr>
<td>How was the doctor at making you feel comfortable?</td>
<td>1</td>
</tr>
</tbody>
</table>

*1 Indicates excellent; 2, very good; 3, good; 4, fair; and 5, poor.
program telephone interpretation phase, which was similar to that in the initial telephone interpretation phase.

For the 8 individual questions, the differences among groups in the mean scores were similar to the differences in total satisfaction scores. Compared with the telephone interpretation phase, the individual scores of each satisfaction item were significantly improved at \( P < .001 \) during the resident education phase, similar to the total satisfaction score. When telephone interpretation was reintroduced, scores for each of the satisfaction items worsened and were not significantly different from the scores in the initial telephone interpretation phase, although “spending enough time” was slightly worse when telephone interpretation was reintroduced (\( P = .02 \)).

**RESIDENT ASSESSMENT OF IN-PERSON INTERPRETER AS RESIDENT EDUCATOR**

For the description of residents at baseline, all 50 residents completed the preprogram questionnaire; of these, 6% reported their ethnicity/race as Latino or part Latino, 74% as white, 10% as Asian, 8% as black, and 6% as other. The results of the survey that was completed by all of the residents before implementation of the program are presented in Table 3. Before implementation of the program, 18.4% of the residents rated use of the telephone interpreter as excellent, a figure that was unchanged at the end of the program. Although 30.6% of residents rated use of an in-person interpreter as an excellent preprogram, 71.4% rated use of an in-person interpreter as an excellent postprogram (\( P = .02 \)).

At the conclusion of the resident education phase, potential benefits of the program were listed in the postprogram questionnaire, and residents were asked to rank the benefits. For the 49 residents responding, the most important benefits of an in-person interpreter were efficiency, convenience, and the ability to make patients feel comfortable, and 10.2% felt that the ability to elaborate on cultural values and home remedies was also important. Examples of statements supporting these benefits are listed in Table 4.

**Table 2. Comparison of Mean Satisfaction Scores Among Interpretation Methods**

<table>
<thead>
<tr>
<th>Satisfaction Item</th>
<th>Telephone (A)</th>
<th>In Person (B)</th>
<th>Cultural Education (C)</th>
<th>Telephone (D)</th>
<th>( P ) Value</th>
<th>B vs A</th>
<th>C vs B</th>
<th>D vs C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total score</td>
<td>17.4</td>
<td>14.5</td>
<td>11.5</td>
<td>17.2</td>
<td>.006</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Listening</td>
<td>2.2</td>
<td>1.6</td>
<td>1.5</td>
<td>2.0</td>
<td>.01</td>
<td>.02†</td>
<td>.02†</td>
<td></td>
</tr>
<tr>
<td>Answering</td>
<td>2.4</td>
<td>2.1</td>
<td>1.7</td>
<td>2.4</td>
<td>.14</td>
<td>.01</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Words</td>
<td>2.4</td>
<td>2.0</td>
<td>1.3</td>
<td>2.3</td>
<td>.02</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Friendly</td>
<td>2.1</td>
<td>1.7</td>
<td>1.4</td>
<td>2.0</td>
<td>.02</td>
<td>.03†</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>2.1</td>
<td>1.8</td>
<td>1.4</td>
<td>2.2</td>
<td>.11</td>
<td>.005</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Respect</td>
<td>1.9</td>
<td>1.7</td>
<td>1.4</td>
<td>1.8</td>
<td>.11</td>
<td>.004</td>
<td>.003</td>
<td></td>
</tr>
<tr>
<td>Concern</td>
<td>2.0</td>
<td>1.7</td>
<td>1.4</td>
<td>2.2</td>
<td>.07</td>
<td>.01</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Comfortable</td>
<td>2.1</td>
<td>1.6</td>
<td>1.4</td>
<td>2.1</td>
<td>.003</td>
<td>.07</td>
<td>&lt;.001</td>
<td></td>
</tr>
</tbody>
</table>

*Phase A was telephone interpretation (n = 91); B, trained in-person interpretation (n = 49); C, in-person interpretation with cultural education of residents (n = 65); and D, postprogram telephone interpretation (n = 45). Lower scores indicate more satisfaction.

†No longer significant when using a cutoff of .017 for significance when applying the Bonferroni correction for multiple comparisons.

**Table 3. Results of Resident Preintervention Survey**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Excellent, %</th>
<th>Very Good, %</th>
<th>Good, %</th>
<th>Fair, %</th>
<th>Poor, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-rated Spanish-speaking ability (n = 50)</td>
<td>2.0</td>
<td>4.0</td>
<td>40.0</td>
<td>20.0</td>
<td>34.0</td>
</tr>
<tr>
<td>Overall ability to take care of Spanish-speaking patients in clinic (n = 50)</td>
<td>8.0</td>
<td>38.0</td>
<td>40.0</td>
<td>12.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Ability to take care of Spanish-speaking patients with use of telephone interpreter (n = 49)</td>
<td>18.4</td>
<td>40.8</td>
<td>26.5</td>
<td>12.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Ability to take care of Spanish-speaking patients with use of in-person interpreter (n = 49)</td>
<td>30.6</td>
<td>32.7</td>
<td>18.4</td>
<td>18.4</td>
<td>0</td>
</tr>
</tbody>
</table>

This study demonstrates that an educational program that includes an interpreter with an interactive role in educating and providing feedback to residents improves satisfaction of Latino parents with LEP. To our knowledge, this is the first study that uses an interpreter as a resident educator and the first study to measure parent satisfaction after educating health care professionals about culture and the use of interpreters. As language barriers between patient and physician become more common in the United States, it is even more critical to develop ways beyond the traditional use of a trained professional interpreter to overcome the negative clinical consequences of these barriers.

This study shows that LEP, Spanish-speaking parents are most satisfied with medical care when an interpreter acts not only to translate words from one language to another but also to interpret cultural meanings.
for both the physician and the patient. This improvement in parent satisfaction is possibly a marker for improvement in communication between non–Spanish-speaking physicians and LEP, Spanish-speaking patients. Our results also suggest that patients are more satisfied with in-person interpretation compared with telephone interpretation. To our knowledge, no previous study has compared the use of in-person interpretation with telephone interpretation. Lee et al have suggested that Spanish-speaking patients using telephone interpretation are more satisfied than patients who use ad hoc interpreters, possibly because telephone interpreters are untrained third parties. In our study, LEP, Spanish-speaking patients who experienced an in-person interpreter were more satisfied than the physician than Latino patients who experienced a standard interpreter, likely because health care professionals were better able to understand the patient and to treat the specific problem by eliminating cultural misunderstanding.

Our program attempts to eliminate problems associated with language barriers by teaching health care professionals how to work most effectively with interpreters and to use select Spanish phrases to establish rapport with their patients. In addition, the program teaches health care professionals about Latino cultural values to diminish cultural barriers. Our study suggests that a physician’s ability to use an interpreter effectively and understand a parent’s culture are important factors in parent satisfaction. An alternative explanation for the improvement in parent satisfaction when the interpreter acted as an educator is that the residents knew that they would be critiqued at the end of the visit and therefore spent more time with the parents. However, residents stated that they were unaware that the interpreter was evaluating them but thought that she was only acting in a helpful manner.

This program, which uses the interpreter as a resident educator, was well received by the residents. Interacting with the interpreter during educational sessions clarified common misunderstandings that occur between Latino patients and non–Spanish-speaking physicians and provided physicians with tools to communicate better with their patients. We also demonstrated that residents rated the use of in-person interpretation better after the program, likely because they learned skills that helped them use an in-person interpreter and because many residents had not previously used in-person interpretation.

This intervention is simple and effective at improving parent satisfaction. One other study demonstrated an improvement in patient satisfaction after a more extensive intervention. In a study by Mazor et al,9 pediatric emergency department physicians took an intensive 10-week Spanish course. Although patient satisfaction improved, problems with false fluency arose when physicians provide medical care in Spanish after a short language course.

Despite the strengths of the study, several limitations deserve mention. This was a small, single-site study with 1 Spanish interpreter, which may limit generalizability. The intervention conducted by the in-person inter-

Table 4. Most Important Benefits of In-Person Interpreter

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Residents Reporting Benefit as Most Important, %</th>
<th>Statement by Resident Explaining Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency and convenience</td>
<td>42.9</td>
<td>“It’s really difficult when you’re on the phone and there are so many delays and you feel like you have a finite amount of time because you’re on the phone. So you basically have to run through everything in your mind immediately. And then, you get off the phone and all of a sudden you remember, Oh, yeah, I have this to ask and great, I don’t have an interpreter anymore.”</td>
</tr>
<tr>
<td>Makes patients comfortable</td>
<td>26.5</td>
<td>“For the patients, … culturally, I think they like having somebody who they can relate to in their own language and who kind of understands some of where they’re coming from better than any of us would.”</td>
</tr>
<tr>
<td>Ability to elaborate on cultural values and home remedies</td>
<td>10.2</td>
<td>One resident stated that the interpreter was helpful when she said, “Well, they went to a healer. Sometimes in this country, that means a curandero who provides herbal remedies.”</td>
</tr>
</tbody>
</table>
educator during October and November, which are typically busy months. The parent satisfaction scores for the 2 telephone interpretation phases, which occurred from May to June and then from December to February, were not significantly different, suggesting that the satisfaction scores were not affected by the season.

A further potential bias may be that the proportion of LEP, Spanish-speaking patients seeing second- or third-year residents was significantly greater in the 2 telephone interpretation phases compared with the 2 in-person interpretation phases. During the 2 telephone interpretation phases, the satisfaction scores were worse than for the in-person interpretation phases even though the residents were more experienced. Although it may seem to be a limitation that the residents’ level of training was not the same among groups, no studies to our knowledge have demonstrated a difference in patient satisfaction based on the year of the resident. In addition, although the mean satisfaction scores were significantly highest when the in-person interpreter was a resident educator, further studies are needed to determine the clinical significance of these results.

In summary, we have demonstrated that a unique intervention in which an interpreter also provides education on cultural and language issues to residents improves the satisfaction of LEP, Spanish-speaking parents. Native Spanish-speaking interpreters not only have the linguistic resources to make communication possible but also possess insights into cultural subtleties that can be taught to health care professionals as they interact with their patients. Wider application of this intervention has the potential to contribute to improvements in health care of LEP, Spanish-speaking patients.

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Author Contributions: Dr Wu, the principal investigator, 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. Study concept and design: Wu, Leventhal, and Forsyth. Acquisition of data: Wu, Ortiz, and Gonzalez. Analysis and interpretation of data: Wu and Forsyth. Drafting of the manuscript: Wu, Leventhal, and Forsyth. Acquisition of data: Wu, Ortiz, and Gonzalez. Analysis and interpretation of data: Wu and Forsyth. Drafting of the manuscript: Wu, Leventhal, and Forsyth. Critical revision of the manuscript for important intellectual content: Wu, Leventhal, Ortiz, Gonzalez, and Forsyth. Administrative, technical, and material support: Ortiz and Gonzalez. Study supervision: Wu, Leventhal, and Forsyth.

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