Examining Effectiveness of Medical Interpreters in Emergency Departments for Spanish-Speaking Patients With Limited English Proficiency: Results of a Randomized Controlled Trial

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Study objectives: This study examines whether availability of in-person professional interpreter services during emergency department (ED) visits affects satisfaction of limited English proficient patients and their health providers, using a randomized controlled trial.

Methods: We randomized time blocks during which in-person professional interpreters were available to Spanish-speaking patients in the EDs of 2 central New Jersey hospitals. We assessed the intervention's effects on patient and provider satisfaction through a multilevel regression model that accounted for the nesting of patients within time blocks and controlled for the patient's age and sex, hospital, and when the visit occurred (weekday or weekend).

Results: During the 7-month intake period, 242 patients were enrolled during 101 treatment time blocks and 205 patients were enrolled during 100 control time blocks. Regression-adjusted results indicate that 96% of treatment group patients were "very satisfied" (on a 5-point Likert scale) with their ability to communicate during the visit compared with 24% of control group patients (odds ratio=72; 95% confidence interval 31 to 167). (Among control group members who were not very satisfied, responses ranged from "very dissatisfied" to "somewhat satisfied.") Similarly, physicians, triage nurses, and discharge nurses were more likely to be very satisfied with communication during treatment time blocks than during control time blocks. We did not assess acuity of illness or global measures of satisfaction.

Conclusion: Use of in-person, professionally trained medical interpreters significantly increases Spanish-speaking limited English proficient patients' and their health providers' satisfaction with communication during ED visits. [Ann Emerg Med. 2010;xx:xxx.]

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INTRODUCTION

Background

Efforts to improve the cultural competency of health care throughout the United States, coupled with the growth of the limited English proficient population, have increased the focus on improving care for limited English proficient patients.[1] A key to meeting this goal is reducing the barriers that arise when a health care provider and patient do not speak the same language. Such barriers can negatively affect both patient and provider satisfaction.[2-9]

Importance

Patient satisfaction in emergency medicine is important because it is associated with improved patient understanding of self-care and follow-up plans, reduced errors, and better treatment adherence.[10-13] Provider satisfaction is important for reducing burnout and staff turnover and may reduce provider errors.[9,14-18] From the hospital's perspective, there might be a business case for maximizing patient satisfaction because it may increase the likelihood of a patient returning to the same emergency department (ED) for care; it could also reduce the likelihood for lawsuits and lead to improved ED throughput.[19-22]

Goals of This Investigation

The mere existence of an association between lack of interpreter services and worse satisfaction does not mean that

Editor's Capsule Summary

What is already known on this topic
Interpretation is needed to provide optimal emergency department (ED) care of patients who do not speak the staff's language. This is often done in person by friends, family, and bilingual staff or by telephone.

What question this study addressed
Does an in-person professional interpreter affect patient satisfaction in an urban ED for limited English proficient, Spanish-speaking patients?

What this study adds to our knowledge
With a random-block allocation study design for 447 patients, satisfaction as measured by a Likert scale was nearly 4-fold higher when a professional interpreter was used in the ED.

How this is relevant to clinical practice
In-person, professional interpreters improve patient satisfaction, though the cost/reward and relative effect on care are not defined.

provision of these services will necessarily improve satisfaction.[4,23,24] Provision of interpreter services may be confounded with patient characteristics that also affect satisfaction. For example, interpreters may be provided during the hospital's busiest periods, and patients treated during busier ED hours may report greater levels of dissatisfaction simply because they are frustrated by the long wait times. Randomized controlled trials thus offer the most rigorous design for establishing the efficacy of interpreter services, but to our knowledge there have only been 2 in this area.[5,6] The study by Garcia et al[5] compared satisfaction levels with different types of interpretation methods (hospital-trained, ad hoc, and telephone) for parents of children treated in a pediatric emergency referral center. The study by Gany et al[6] was designed to compare satisfaction with a simultaneous interpretation method (also known as the UN model) versus consecutive interpretation techniques. We report the results of a randomized controlled trial of professional, in-person interpreter services in an ED to Spanish-speaking limited English proficient adult patients and to Spanish-speaking limited English proficient parents of pediatric patients. The study provides additional evidence about differences in the effectiveness of interpretation methods by comparing 2 commonly used techniques (professional versus ad hoc) and expands on previous work by using different settings (adult and pediatric ED patients treated in 2 hospitals) and using sufficient sample size to examine the magnitude of effects.

MATERIALS AND METHODS

Setting

We conducted the study in the EDs of 2 central New Jersey hospitals. One ED is a Level I trauma center serving 63,000 adult patients per year within an acute care facility with 584 inpatient beds (Hospital 1). The second is a Level II emergency facility that serves 50,000 patients (adult and pediatric) per year and is located in an acute care medical center licensed for 271 beds (Hospital 2). Data collection occurred from October 2008 through April 2009.

We used a cluster-randomized design[25,26] in which time blocks, instead of individuals, were assigned to treatment or control conditions. At the beginning of the study, we identified times when the ED did not have an in-person interpreter available and divided those times into blocks that were 4 to 5 hours long. Approximately once a month, a statistician used a SAS computer program, version 9.1.3 (SAS Institute, Inc., Cary, NC) to randomly assign (within a set of time blocks defined by the hospital and whether the time block was on a weekend or weekday) one-half of the eligible time blocks for the following month as "control" and one-half as "treatment" time blocks. Patients treated in the control time blocks were provided with the usual language services available in the ED (including a telephone interpretation service and ad hoc interpreter services provided by bilingual staff and family members or friends of the patient). During treatment time blocks, a professionally trained medical interpreter was available, along with the ED's usual language services. There were 5 treatment interpreters: 3 worked at Hospital 1 only, 1 worked at Hospital 2 only, and 1 worked at both hospitals. All were certified bilingual in Spanish and English and had completed (1) at least 40 hours of training in medical terminology, ethics, patient privacy, and basic interpreting skills; and (2) an online course in protection of human subjects. This design enabled us to test a realistic scenario: If a hospital's ED offers professionally trained medical interpreter services during some shifts, would providers' and Spanish-speaking patients' satisfaction with the visits improve during those shifts?

One of 8 bilingual research assistants was present during all study time blocks to explain the study, obtain informed consent, and collect data. All were trained on study procedures (such as administering informed consent) and were certified bilingual in Spanish and English. However, they had not completed the required training for medical interpretation, so they did not provide assistance with medical care in either the treatment or control conditions.

An independent institutional review board, as well as the institutional review boards of the 2 participating hospitals, approved the study protocol. Because both participating hospitals provided access to a telephone interpretation service and this research design did not deny anyone access to in-person professional services when they were available, no patients were worse off from participating in this study. Additionally, the cluster-randomized design addressed the ethical concerns over

denying control patients access to services that could improve the quality of their care when such services were available.[27,28]

Selection of Participants

Because of budget and other practical considerations, this study was limited to Spanish-speaking limited English proficient patients. The study excluded cognitively impaired or comatose patients and patients who were too distressed (as determined by the triage nurse) to provide informed consent; these patients were considered refusals. To avoid any appearance of coercion, we also excluded employees of the 2 hospitals (if they came to the hospital as patients). Pediatric patients were excluded at Hospital 1 because it had a separate pediatric ED that would have required a separate study procedure. At Hospital 2, for the 17 cases involving children younger than 18 years, parents provided informed consent and were the subjects of the satisfaction survey; because these children were minors, their parents presumably had responsibility for communicating with the providers on health care decisions. All other limited English proficient Spanish-speaking patients treated during the treatment and control time blocks were invited to participate in the study.

ED staff identified eligible patients at registration or triage according to their assessment of potential language barriers or the patient's request for interpreter services. We followed the hospitals' usual procedures for identifying limited English proficient patients to avoid introducing bias into the identification of potential research subjects. Although it is possible that some patients in need of language services were missed with these procedures, we cannot estimate the number; however, we do not believe that the number of missed cases would have been substantially different for the treatment and control time blocks. The bilingual research assistant obtained informed consent from all study participants but was not blinded to treatment or control group status because it was not possible to conceal the presence of an interpreter.

Because the satisfaction analyses were part of a larger study that included a wide range of outcome measures (including the costs and services used during the ED stay and satisfaction measures), we developed enrollment targets that would be sufficient to detect small to medium effect sizes, using patient satisfaction as our primary outcome of interest. Our original power analysis suggested that enrolling 360 patients per hospital from 180 time blocks, 50% of which would be assigned treatment status, would provide us with 80% power to detect an effect size of SD=0.22, assuming that (1) a 2-tailed test at the 5% level is used, (2) 20% of variance in the primary outcome was between time blocks (interclass correlation coefficient=0.20), and (3) treatment and hospital indicators explained 25% of the variability between time blocks (R^2=0.25). We anticipated that it would take 6 to 12 weeks to reach the enrollment targets at each hospital. However, the enrollment of Spanish-speaking patients at Hospital 2 was much lower than expected, which led us to terminate the study at that hospital after 6 weeks. At Hospital 1, we stopped randomizing new time blocks (though we still held sessions that had already been randomized) after reaching the target number of patients (360) at that hospital. At that point, we had randomized 143 time blocks at Hospital 1. Even with the smaller sample (because of discontinuing operations at 1 hospital), minimum detectable effects were approximately SD=0.3. The resulting minimal detectable effects were expected to be sufficient to detect effects on satisfaction outcomes because past research suggested that the effect of interpreters and language barriers on satisfaction were relatively large.[5,29]

Methods of Measurement

After each medical encounter, a research assistant distributed brief satisfaction surveys to patients, ED triage and discharge nurses, and attending emergency physicians. Although the patient satisfaction survey was available in English and Spanish, all patients responded to the Spanish version; the provider satisfaction survey was available only in English. Patients completed the survey before discharge; providers completed their surveys immediately after treating the patient. In a few cases, when the patients had limited reading ability, the research assistant read the survey questions to the patients and recorded their responses.

Because both hospitals have contracts with Press-Ganey to conduct client surveys and due to copyright restrictions, we were unable to include a global satisfaction measure for the ED visit. Instead, we used satisfaction measures that were appropriate for the ED setting. The patient survey questions were adapted from questions from the Consumer Assessment of Healthcare Providers and Systems Hospital Survey (available online at http://www.cahps.ahrq.gov).[30] Specifically, the 2 questions used were "How satisfied were you with the way you and hospital staff were able to communicate?" and "How easy was it for you to understand the things that were explained to you?" The provider survey asked, "How satisfied are you that language issues were adequately addressed to assess and treat this patient's condition?" which was adapted from a study by Kamath et al.[31] The surveys used a Likert scale for response categories, with 1 indicating "very satisfied" or "very easy" and 5 indicating "very dissatisfied" or "did not understand at all." Appendix E1 (available online at http://www.annemergmed.com) contains the instruments.

For the analysis, response categories were dichotomized for all measures, with 1 indicating "very satisfied" or "very easy" and 0 indicating any response other than "very satisfied" or "very easy." We collapsed the measures because few treatment group members (less than 10%) chose responses 2 to 5 on each of the outcome measures' 5-point scales. However, we ran sensitivity tests (as noted below) that used the full range of responses for each outcome measure.

Primary Data Analysis

We drafted our analysis plan before the start of data collection and examined the specific question of the "intent-to-

treat" effects of interpreter availability on patient/provider satisfaction levels. During the study, we randomly assigned 201 time blocks to either the treatment or control group. Because patients treated in one of the EDs during the same time block were served by the same set of staff members, the satisfaction of patients (and providers) within a time block may be more similar than the satisfaction of patients (and providers) across time blocks. For instance, fewer patients may regularly be treated in one time block, whereas another time block regularly experiences an overabundance of patients. Clearly, in this case, the time block in which a patient arrives may have a strong influence on patient (or provider) satisfaction after a visit. We accounted for this nesting of patients within time blocks by using logistic multilevel regression models, which include random time-block effects, so that all patients served within a time block share the same random effect.[32]

To increase the precision of the estimates, in addition to the dummy variable for treatment, we also controlled for whether the time block occurred during a weekend or weekday, the hospital in which the patient was treated, and the sex and age of the patient. We used similar models for patients' understanding and physicians', triage nurses', and discharge nurses' satisfaction. We used HLM 6.07 software (Scientific Software International, Lincolnwood, IL) to estimate all multilevel models[33] (see Appendix E1, available online at http://www.annemergmed.com, for more details on the modeling approach).

Sensitivity Analyses

To examine the sensitivity of the results to these control variables, we also analyzed logistic multilevel models without any additional covariates (ie, the only included covariate was treatment status); the results did not change. Therefore, all of the results reported are from the models that control for all available patient and time-block characteristics. As a sensitivity test, we also ran a linear multilevel regression model that did not collapse the outcome measure and obtained qualitatively similar results to the logistic multilevel regression models (Table E1, available online at http://www.annemergmed.com).

RESULTS

Of the 531 patients invited to participate in the study, 47 (9%) refused. The primary reason for refusal was that the patient was accompanied by an English-speaking friend or relative who could act as an interpreter during the encounter, so the patient did not see a reason to participate. In several cases, refusals were due to perceived time constraints that study participation would impose. Because some patients were treated more than once during the study period, the study also excluded the 37 (7%) patients who were already participating in the study. Therefore, our final sample includes data for the first-time visits of 242 treatment group patients and 205 control group patients. As noted earlier, we terminated recruitment at Hospital 2 after 6 weeks; therefore, only 10% of patients were from Hospital 2. The Figure shows the pattern of participant attrition during treatment and control time blocks.

Of the 231 survey respondents in the treatment group, 227 reported receiving the intervention, a professional interpreter (Table 1). Because of high patient volume in the ED and interpreter scheduling, 1 patient received no interpreter services and 17 patients treated during treatment time blocks received another type of language service (in addition to or instead of a professional interpreter) for part of their ED visit. Within the control group, 66 patients did not receive any interpreter services during their ED visits, and 114 patients reported receiving the hospital's usual language services (including family member or friend, interpreter on telephone, physician or nurse, or other). Eleven patients treated during the control time blocks reported receiving services from an in-person interpreter (in addition to or instead of the ED's usual language services); however, because there was no trained interpreter staffed during these times, these patients likely mistook other hospital staff members for a trained interpreter. In the control group, patients who indicated that the physician or nurse spoke their language indicated easier understanding and higher satisfaction than those who did not receive any interpreter services (Table E2, available online at http://www.annemergmed.com).

On average, there were 2.2 patients per time block. By chance, treatment group patients were slightly younger than control group members (average ages were 35.2 and 38.5 years, respectively) (Table 2). Differences for sex, hospital, and whether the visit occurred on a weekend or weekday between the treatment and control groups were small and insignificant. Patient disposition was also similar for the treatment and control groups, with 8% of each group hospitalized at the end of the ED visit (not shown), which suggests that the severity of illness was similar for patients treated during both time blocks. However, disposition is a postintervention measure; data were not available on acuity or severity of illness at triage.

Overall, survey participation rates were high; 95% of patients returned surveys, as did 95%, 96%, and 83% of physicians, triage nurses, and discharge nurses, respectively. Participation rates were lower for discharge nurses because many patients were still awaiting discharge when interviewers' shifts ended for the day. Table 3 presents raw counts and percentages of responses to the satisfaction questions, as well as the responses for each category, by treatment group status. Tables E3A and B (available online at http://www.annemergmed.com) provide these same data by hospital. Unadjusted results show that more than 90% of treatment group patients were very satisfied with communication and very few were dissatisfied; in the control group, the responses were more evenly distributed across the 5 categories. Physicians, triage nurses, and discharge nurses also reported very high levels of satisfaction if they served a patient during a treatment block, but they reported a wide range of responses if they served a patient during a control time block.

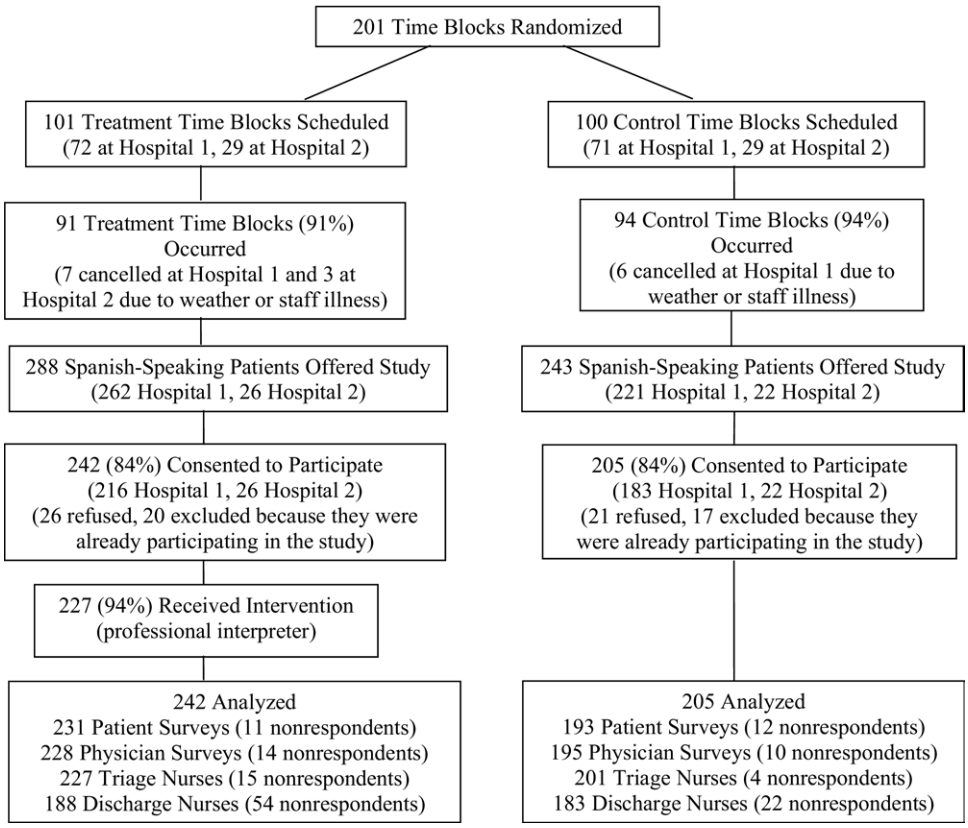

Figure. Participant attrition during treatment and control time blocks.

Table 1. Type of interpreter services received, by treatment group status.*

Interpretation Method	Treatment Group (n=231)	Control Group (n=193)
In-person interpreter—provided by hospital	227 (98.3)	11 (5.7)
Family member/friend interpreted for me	4 (1.7)	47 (24.4)
Interpreter on telephone—provided by hospital	1 (0.4)	23 (11.9)
Physician/nurse spoke my language	11 (4.8)	43 (22.3)
Other	1 (0.4)	12 (6.2)
Not applicable (did not receive services)	1 (0.4)	66 (2.6)
Don't know	0 (0)	5 (34.2)

*This table includes numbers (percentages) for the types of interpreter services received during the first visit of patients who completed satisfaction surveys. Percentages do not total to 100 because some patients selected multiple responses.

Table 2. Baseline characteristics, by treatment group status.*

Time block characteristics	Overall (n=447)	Treatment Group (n=242)	Control Group (n=205)
Hospital†			
Hospital 1	399 (89.3)	216 (89.3)	183 (89.3)
Hospital 2	48 (10.7)	26 (10.7)	22 (10.7)
Time of the visit			
Weekday	231 (51.7)	131 (54.1)	100 (48.8)
Weekend	216 (48.3)	111 (45.9)	105 (51.2)
Patient demographic characteristics			
Sex†			
Female	258 (58.1)	145 (59.9)	113 (55.9)
Male	186 (41.9)	97 (40.1)	89 (44.1)
Mean age, y†	36.7 (SD=15.1)	35.2 (SD=14.5)	38.5 (SD=15.7)

*Data are presented as numbers (percentages), unless otherwise specified. Percentages may not total to 100 because of rounding. There were 201 time blocks randomized (101 treatment and 100 control) and an average of 2.2 patients per time block.
†We terminated recruitment in Hospital 2 early because it did not serve as many Spanish-speaking limited English proficient patients as originally expected.
‡Three patients in the control group were missing age and sex data and were excluded here and from the analysis presented in Table 3.

The regression-adjusted results indicate that the intervention significantly and dramatically increased patients' and providers' satisfaction with the visit (Table 4). In the treatment group, 96% of the patients who answered the satisfaction survey were very satisfied with the visit; in the control group, only 24% were very satisfied (odds ratio=72; 95% confidence interval [CI]=31 to 167). In the treatment group, 93% of the patients found it very easy to understand the visit interactions versus only 18% of patients in the control group (odds ratio=61; CI=23 to 166).

Similarly, more than 94% of physicians, triage nurses, and discharge nurses treating patients during the treatment time blocks were very satisfied with the visits; fewer than 23% of providers were satisfied with the visits during the control time

Table 3. Raw survey satisfaction data, by treatment group status.*

	Treatment Group (n=242)		Control Group (n=202)	
Outcome Measure	**No.**	**(%)**	**No.**	**(%)**
Patient understanding				
Very easy	213	(88.0)	32	(15.6)
Mostly easy	13	(5.4)	42	(20.5)
Somewhat easy	2	(0.8)	50	(24.4)
Not so easy	3	(1.2)	60	(29.3)
Not easy at all (did not understand)	0	0	9	(4.4)
Don't know/refused/did not respond	11	(4.6)	12	(5.9)
Patient satisfaction				
Very satisfied	221	(91.3)	44	(21.5)
Somewhat satisfied	9	(3.7)	81	(39.5)
Neither satisfied nor dissatisfied	0	0	4	(2.0)
Somewhat dissatisfied	1	(0.4)	48	(23.4)
Very dissatisfied	0	0	16	(7.8)
Don't know/refused/did not respond	11	(4.5)	12	(5.9)
Physician satisfaction				
Very satisfied	215	(88.8)	36	(17.6)
Somewhat satisfied	4	(1.7)	55	(26.8)
Neither satisfied nor dissatisfied	6	(2.5)	22	(10.7)
Somewhat dissatisfied	0	0	48	(23.4)
Very dissatisfied	3	(1.2)	34	(16.6)
Don't know/refused/did not respond	14	(5.8)	10	(4.9)
Triage nurse satisfaction				
Very satisfied	223	(92.2)	38	(18.5)
Somewhat satisfied	1	(0.4)	40	(19.5)
Neither satisfied nor dissatisfied	2	(0.8)	22	(10.7)
Somewhat dissatisfied	1	(0.4)	42	(20.5)
Very dissatisfied	0	0	59	(28.8)
Don't know/refused/did not respond	15	(6.2)	4	(2.0)
Discharge nurse satisfaction				
Very satisfied	176	(72.7)	35	(17.1)
Somewhat satisfied	5	(2.1)	48	(23.4)
Neither satisfied nor dissatisfied	3	(1.2)	16	(7.8)
Somewhat dissatisfied	2	(0.8)	46	(22.4)
Very dissatisfied	2	(0.8)	38	(18.5)
Don't know/refused/did not respond	54	(22.3)	22	(10.7)

*This table includes satisfaction and understanding numbers (percentages) for the first visit of all eligible patients during the study. Survey questions for outcome measures were as follows: patient understanding: How easy was it for you to understand the things that were explained to you?; patient satisfaction: How satisfied were you with the way you and hospital staff were able to communicate?; provider (physician, triage nurse, and discharge nurse) satisfaction: How satisfied are you that language issues were adequately addressed to assess and treat this patient's condition?

blocks. Odds ratios were 88, with a 95% CI of 39 to 198 (physicians); 58, with a 95% CI of 3 to 1,052 (triage nurses); and 81, with a 95% CI of 64 to 104 (discharge nurses).

LIMITATIONS

Our study may have limited generalizability because it was conducted in only 2 central New Jersey hospitals. However, the 2 hospitals were large urban and suburban facilities with busy EDs treating a wide mix of typical ED problems and serving a broad sociodemographic mix of patients, including large Latino immigrant populations. There is no reason to suspect that results would be substantially different from those of EDs in other large, acutecare general hospitals. Our results are generally consistent with those of studies of language barriers in other health care settings (such as outpatient clinics and pediatric EDs), but the magnitudes of effects may differ by setting. For example, intervention results might not be the same in the case of primary care patients who have established ongoing continuous relationships with a set of health care providers. In addition, our study enrolled Spanish-speaking limited English proficient patients only; satisfaction effects might not be the same for speakers of other languages or patients from different cultural backgrounds. We did not collect data on acuity or severity of illness, 2 variables that have been shown to influence patient satisfaction (more severely ill patients tend to be less satisfied than those with less severe illnesses)[34]; however, the randomization of different time blocks should have ensured that even unmeasured patient characteristics were well balanced between treatment and control groups. Finally, our study outcomes were limited to satisfaction measures that were focused on communication; we were not able to collect global satisfaction measures. Other important outcome measures, including those related to health care costs and use, were not a part of this analysis, but they were analyzed, and the results are forthcoming.

DISCUSSION

In this randomized controlled trial, we found that the provision of professionally trained, in-person medical interpreters to adult, limited English proficient, Spanish-speaking ED patients (and to Spanish-speaking limited English proficient parents of pediatric ED patients) greatly increased patients' and providers' satisfaction. All types of providers surveyed showed large increases in satisfaction. These results are consistent with many observational results reported in the literature.[15,27,28,35,36]

Collectively, studies of language barriers and their effects on satisfaction ratings in hospital EDs have found that non-English-speaking patients who do not receive interpreter services have lower satisfaction levels, are less willing to return to the same ED for care, and report more problems with care than English-speaking patients than those who use an interpreter.[27-29] The use of professional interpreters was associated with higher patient and provider satisfaction levels despite the fact that no existing interpretation strategies have been able to approximate an encounter in which the patient and provider speak the same language [2,4-6]

Our results are also consistent with those of the 2 other published randomized controlled trials of interpreter services in the ED of which we are aware.[5,6] However, our study expands on this work based on a number of differences in the design. First, the study by Gany et al[6] focused on a method of interpretation (remote simultaneous) that is relatively new to the health care sector and combined trained interpreters with ad hoc interpreters into the same comparison group. This is

Table 4. Effect of professionally trained medical-interpreter services on patients' and providers' satisfaction with ED visit: Probability of "very easy" to understand or being "very satisfied" with the ED visit.*

	Treatment Group		Control Group		Treatment Effectiveness		
Outcome	**n**	**Estimated Percentage**	**n**	**Estimated Percentage**	**Odds Ratio**	**95% CI**	***P***
Patient understanding	231	93.0	191	17.8	61.2	22.5–165.7	.01
Patient satisfaction	231	95.8	190	23.9	71.9	30.8–167.4	.01
Physician satisfaction	228	94.8	192	17.1	87.9	39.0–197.9	.01
Triage nurse satisfaction	227	94.3	198	22.3	57.7	3.1–1,051.7	.01
Discharge nurse satisfaction	188	94.6	180	17.8	81.2	63.6–103.6	.01

*All estimates are based on multilevel logistic regression model, with patients (at level 1) nested within time blocks (at level 2), controlling for age, sex, hospital, and weekend/weekday. Sample size (n) refers to the number of patients within a group who were included in the analysis for a given outcome; individuals who were missing covariates or outcomes were excluded from these analyses. There were 201 time blocks randomized (101 treatment and 100 control) and an average of 2.2 patients per time block. Sample sizes vary by outcome because some patients and health providers did not return satisfaction surveys. An odds ratio of 1 indicates that the treatment is no more effective than the control condition.

problematic because previous research has found significant differences in satisfaction levels across these 2 groups, a finding this study confirms.[5,9,15] Second, our study examined both patient and provider satisfaction levels within the same sample and found a high degree of concordance in satisfaction ratings across all groups. Finally, we used a new approach to studying ED interpreter services by randomly assigning time blocks rather than patients to treatment groups, a design that avoids ethical concerns of denying control patients potentially beneficial services when they are available. Through this combination of methods, our study provides more real-life clinical, administrative, and policy-relevant information than previous research.

Increased satisfaction levels could play a role in making the business case for funding interpreter services in these settings if, for example, patient satisfaction levels are associated with greater willingness to return to the same ED for future health care needs, as has been found in other research.[37,38] However, beyond patients' and providers' satisfaction, improved communication from interpreter services may yield additional essential benefits for quality and efficiency of care. For example, interpreters could lead to more accurate patient assessment on arrival in the ED, which could be reflected in a more accurate triage acuity assignment and a shorter wait for receipt of appropriate treatment. The in-person interpreter can provide additional information on body gestures and other nonverbal communication that can assist with patient assessment. Second, an in-person interpreter can assist in explaining procedures necessary for diagnosis and treatment. For example, the in-person interpreter will be better able to assist in explaining to a patient how to drink oral contrast properly for diagnostic examinations. Third, an in-person interpreter can provide a presence for the patient, which may help to alleviate anxiety and thereby improve patient cooperation with unfamiliar tests and procedures. Fourth, improved communication with patients can help ED staff gain a better understanding of a patient's overall needs, which may improve patient safety (for example, identifying allergies to potential medications, medication history, and identification of other high-risk problems, such as intimate partner violence and drug and alcohol abuse). Finally, if the discharge plan is clear to the patient, he or she will be more likely to comply with the treatment regimen, which may reduce the likelihood of the patient's requiring a return visit for the same problem. Although telephone interpreters may have some capacity to assess patient understanding of discharge instructions through direct questioning, they cannot capture nonverbal cues that suggest uncertainty or misunderstanding.

In summary, our "practical" randomized controlled trial introduced a methodological enhancement (randomizing time blocks or shifts) that other similar studies may find useful. More important, the study showed extremely large effects of in-person professional interpreters on patient and provider satisfaction for limited English proficient Spanish-speaking ED patients. Despite studies showing that, in most situations, providing in-person professional interpreters is the best alternative for improving patient-provider communication when bilingual providers are unavailable,[15,23,24,39] many providers continue to rely on ad hoc interpreters (for example, family members and untrained bilingual staff) and telephone interpreters to meet their needs for language services.[40-42] Our study provides additional evidence for the benefits of in-person trained interpreters. Future research will study the effects of interpreter services on other cost and utilization outcomes beyond satisfaction.

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Editor's Capsule Summary *What question this study addressed:* Does an in-person professional interpreter affect patient satisfaction in an urban emergency department (ED) for limited English proficient, Spanish-speaking patients? *What this study adds to our knowledge:* With a random-block allocation study design for 447 patients, satisfaction as measured by a Likert scale was nearly 4-fold higher when a professional interpreter was used in the ED.

APPENDIX E1. SUPPLEMENTAL MATERIALS AND METHODS.

This appendix has 4 sections: (1) the survey instruments, (2) statistical modeling, (3) sensitivity tests, and (4) additional tables.

SURVEY INSTRUMENTS

The survey instrument was provided to patients in both English and Spanish and to physicians and nurses in English. The Spanish translation is available on request.

Physician/Nurse Satisfaction Survey

1. How satisfied are you that language issues were adequately addressed to assess and treat this patient's condition? Were you very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, or very dissatisfied?
   - Very satisfied 1
   - Somewhat satisfied 2
   - Neither satisfied nor dissatisfied 3
   - Somewhat dissatisfied 4
   - Very dissatisfied 5
   - Don't know d
   - Refused r

Patient Satisfaction Survey

1. Did you receive any interpreter services during your visit?
   - Yes 1 Continue →
   - No 0 Go to Q.2 →
   - 1a. What type of interpreter services did you receive?
     - In-person interpreter—provided by hospital 1
     - Family member/friend interpreted for me 2
     - Interpreter on telephone—provided by hospital 3
     - Physician/nurse spoke my language 4
     - Other (specify) 5
     - Don't know d
     - Refused r
2. How easy was it for you to understand the things that were explained to you? Was it very easy, mostly easy, somewhat easy, not so easy, or not easy at all?
   - Very easy 1
   - Mostly easy 2
   - Somewhat easy 3
   - Not so easy 4
   - Not easy at all (did not understand) 5
   - Don't know d
   - Refused r
3. How satisfied were you with the way you and hospital staff were able to communicate? Were you very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, or very dissatisfied?
   - Very satisfied 1
   - Somewhat satisfied 2
   - Neither satisfied nor dissatisfied 3
   - Somewhat dissatisfied 4
   - Very dissatisfied 5
   - Don't know d
   - Refused r

STATISTICAL MODELING

Because the time blocks were randomly assigned to treatment groups instead of patients and because patients arriving at the ED during the same time block in a given hospital were served by the same set of staff members, the satisfaction of patients (and providers) within a time block may be more similar than the satisfaction of patients (and providers) across time blocks. Our statistical analyses take this nesting of patients within time blocks into account by using multilevel logistic regression models[30] of the following form:

$$\log\frac{P(Y_{ij}=1)}{P(Y_{ij}=0)} = \gamma_0 + \delta * Trt_j + \gamma_1 * Weekend_j + \gamma_2 * Hospital2_j + \gamma_3 * Female_{ij} + \gamma_4 * (Age < 25)_{ij} + \gamma_4 * (35 < Age \leq 50)_{ij} + \gamma_4 * (Age > 50)_{ij} + u_j$$

This model accounts for nesting of patients within time blocks by including a random effect, u_j, so that all patients served during time block j share the same random effect u_j. Because the patient's satisfaction outcome, Y_{ij}, for patient i in time block j was binary (1 if the patient was very satisfied with the visit and 0 otherwise), we used a logistic link function. To increase the precision of the estimates, we also controlled for whether the time block occurred during a weekend or weekday, the hospital in which the patient was treated, and the sex and age of the patient. The treatment effect is represented by parameter δ in the regression equation above. Similar models were used for patients' understanding and physicians', triage nurses', and discharge nurses' satisfaction. We used HLM 6.07[31] with a penalized quasi-likelihood estimation method to estimate all multilevel logistic regression models. To see how well the statistical models fit the data, we examined plots of residuals. We detected no violations of model assumptions, including normality, homoscedasticity (equal variance), or functional form. Results from the population-average model are reported; however, the results of the unit-specific model are similar.

SENSITIVITY TESTS

We ran several sensitivity tests. First, we estimated a linear multilevel regression model that did not collapse the outcome measure. As shown in Table E1, we obtained qualitatively similar results to the bivariate models. For example, mean patient understanding (on a Likert scale where 1=very satisfied and 5=very dissatisfied) for the treatment group was 1.1 (95% CI=1.0 to 1.3), whereas mean patient understanding for the control group was 2.9 (95% CI=2.7 to 3.0). Second, we estimated models that interacted the hospital and treatment status and the weekend and treatment status. In general, these results indicated that the treatment effect did not vary by hospital or by whether the visit oc-

Table E1. Effect of professionally trained medical-interpreter services on patient's and provider's satisfaction with emergency department visit using a multilevel linear model.*

	Treatment Group			Control Group			Estimated Effect				
Outcome Measure	n	Predicted Mean	Standard Error	n	Predicted Mean	Standard Error	Treatment-Control Difference	Standard Error	95% CI Lower Bound	95% CI Upper Bound	*P*
Patient understanding	231	1.112331	0.073702	191	2.867623	0.077182	−1.75529	0.106323	−1.96369	−1.54690	<.001
Patient satisfaction	231	1.054582	0.079612	190	2.545632	0.083359	−1.49105	0.114894	−1.71624	−1.26586	<.001
Physician satisfaction	228	1.084791	0.096524	192	2.896951	0.099668	−1.81216	0.138408	−2.08344	−1.54088	<.001
Triage nurse satisfaction	227	1.048404	0.108353	198	3.206943	0.11108	−2.15854	0.155179	−2.46269	−1.85439	<.001
Discharge nurse satisfaction	188	1.138954	0.108187	180	2.942340	0.108458	−1.80339	0.153049	−2.10336	−1.50341	<.001

*All outcome measures are on a 5-point Likert scale. For satisfaction outcomes, 1=very satisfied and 5=very dissatisfied. For understanding measure, 1=very easy and 5=did not understand at all. All estimates are based on a multilevel linear regression model, with patients (at level 1) nested within time blocks (at level 2), controlling for age, sex, hospital, and weekend/weekday. All control covariates were centered around their grand means. Sample size (n) refers to the number of patients within a group who were included in the analysis for a given outcome; individuals who were missing covariates or outcomes were excluded from these analyses. There were 201 time blocks randomized (101 treatment and 100 control) and an average of 2.2 patients per time block. Sample sizes vary by outcome because some patients and health providers did not return satisfaction surveys. An odds ratio of 1 indicates that the treatment is no more effective than the control condition.

curred on the weekend, so we focused on results from the models that did not include these interaction terms. Finally, we inspected the frequency of responses by interpreter. Satisfaction was high across all interpreters, with more than 90% of physicians, 90% of triage nurses, and 85% of discharge nurses being very satisfied with communication when we examined outcomes for each of the 5 interpreters separately. Thus, we did not mask any important distinctions across interpreters by including a treatment indicator that captured the average effect across all interpreters.

Table E2. Satisfaction and understanding of patients in the control group, by type of interpreter services received.*

	"Doctor/Nurse Spoke My Language" (n=43)		Did Not Receive Any Interpreter Services (n=66)	
Outcome Measure	**No.**	**%**	**No.**	**%**
Patient understanding				
Very easy	9	(20.9)	3	(4.5)
Mostly easy	9	(20.9)	12	(18.2)
Somewhat easy	16	(37.2)	13	(19.7)
Not so easy	8	(18.6)	33	(50.0)
Not easy at all (did not understand)	1	(2.3)	5	(7.6)
Don't know/refused/missing	0	0	0	0
Patient satisfaction				
Very satisfied	12	(27.9)	7	(10.6)
Somewhat satisfied	23	(53.5)	21	(31.8)
Neither satisfied nor dissatisfied	1	(2.3)	1	(1.5)
Somewhat dissatisfied	5	(11.6)	27	(40.9)
Very dissatisfied	1	(2.3)	10	(15.2)
Don't know/refused/missing	1	(2.3)	0	0

*This table includes satisfaction and understanding numbers (percentages) for the first visit of patients in the control group who for the question "What type of interpreter services did you receive?" designated either "not applicable" (did not receive services) or "doctor/nurse spoke my language." Percentages may not total to 100 because of rounding. Survey questions for outcome measures were as follows: patient understanding: How easy was it for you to understand the things that were explained to you?; patient satisfaction: How satisfied were you with the way you and hospital staff were able to communicate?

Table E3A. Raw survey satisfaction data, by treatment group status, for Hospital 1.*

	Treatment Group (n=216)		Control Group (n=183)	
Outcome Measure	**No.**	**%**	**No.**	**%**
Patient understanding				
Very easy	194	(89.8)	29	(15.9)
Mostly easy	8	(3.7)	41	(22.4)
Somewhat easy	1	(0.5)	43	(23.5)
Not so easy	3	(1.4)	51	(27.9)
Not easy at all (did not understand)	0	0	8	(4.4)
Don't know/refused/nonrespondent	10	(4.6)	11	(6.0)
Patient satisfaction				
Very satisfied	197	(91.2)	38	(20.8)
Somewhat satisfied	8	(3.7)	77	(42.1)
Neither satisfied nor dissatisfied	1	(0.5)	2	(1.1)
Somewhat dissatisfied	0	0	39	(21.3)
Very dissatisfied	0	0	15	(7.8)
Don't know/refused/nonrespondent	10	(4.6)	12	(6.6)
Physician satisfaction				
Very satisfied	194	(89.8)	25	(13.7)
Somewhat satisfied	4	(1.9)	50	(27.3)
Neither satisfied nor dissatisfied	6	(2.8)	20	(10.9)
Somewhat dissatisfied	2	(0.1)	45	(24.6)
Very dissatisfied	0	0	33	(18.0)
Don't know/refused/nonrespondent	10	(4.6)	10	(5.5)
Triage nurse satisfaction				
Very satisfied	199	(92.1)	33	(18.0)
Somewhat satisfied	0	0	38	(20.8)
Neither satisfied nor dissatisfied	2	(0.1)	18	(9.8)
Somewhat dissatisfied	1	(0.5)	39	(21.3)
Very dissatisfied	0	0	52	(28.4)
Don't know/refused/nonrespondent	14	(6.5)	3	(1.6)
Discharge nurse satisfaction				
Very satisfied	157	(72.7)	25	(13.7)
Somewhat satisfied	4	(1.9)	45	(24.6)
Neither satisfied nor dissatisfied	3	(1.4)	13	(7.1)
Somewhat dissatisfied	2	(0.1)	43	(23.5)
Very dissatisfied	2	(0.1)	36	(19.7)
Don't know/refused/nonrespondent	48	(22.2)	21	(11.5)

*This table includes satisfaction and understanding numbers (percentages) for the first visit of all eligible patients during the study. Survey questions for outcome measures were as follows: patient understanding: How easy was it for you to understand the things that were explained to you?; patient satisfaction: How satisfied were you with the way you and hospital staff were able to communicate?; provider (physician, triage nurse, and discharge nurse) satisfaction: How satisfied are you that language issues were adequately addressed to assess and treat this patient's condition?

Table E3B. Raw survey satisfaction data, by treatment group status, for Hospital 2.*

	Treatment Group (n=26)		Control Group (n=22)	
Outcome Measure	**No.**	**%**	**No.**	**%**
Patient understanding				
Very easy	19	(73.1)	3	(13.6)
Mostly easy	5	(19.2)	1	(4.5)
Somewhat easy	1	(3.8)	7	(28.8)
Not so easy	0	0	9	(40.9)
Not easy at all (did not understand)	0	0	1	(4.5)
Don't know/refused/nonrespondent	1	(3.8)	1	(4.5)
Patient satisfaction				
Very satisfied	24	(92.3)	6	(27.3)
Somewhat satisfied	1	(3.8)	4	(18.2)
Neither satisfied nor dissatisfied	0	0	2	(9.1)
Somewhat dissatisfied	0	0	9	(40.9)
Very dissatisfied	0	0	1	(4.5)
Don't know/refused/nonrespondent	1	(3.8)	0	0
Physician satisfaction				
Very satisfied	21	(80.8)	11	(50.0)
Somewhat satisfied	5	(19.2)	5	(22.7
Neither satisfied nor dissatisfied	0	0	2	(9.1)
Somewhat dissatisfied	0	0	3	(13.6)
Very dissatisfied	0	0	1	(4.5)
Don't know/refused/nonrespondent	0	0	0	0
Triage nurse satisfaction				
Very satisfied	24	(92.3)	5	(11.7)
Somewhat satisfied	1	(3.8)	2	(9.1)
Neither satisfied nor dissatisfied	0	0	4	(18.2)
Somewhat dissatisfied	0	0	3	(13.6)
Very dissatisfied	0	0	7	(28.8)
Don't know/refused/nonrespondent	1	(3.8)	1	(4.5)
Discharge nurse satisfaction				
Very satisfied	19	(73.1)	10	(45.5)
Somewhat satisfied	0	0	3	(13.6)
Neither satisfied nor dissatisfied	1	(3.8)	3	(13.6)
Somewhat dissatisfied	0	0	3	(13.6)
Very dissatisfied	0	0	2	(9.1)
Don't know/refused/nonrespondent	6	(23.1)	1	(4.5)

*This table includes satisfaction and understanding numbers (percentages) for the first visit of all eligible patients during the study. Survey questions for outcome measures were as follows: patient understanding: How easy was it for you to understand the things that were explained to you?; patient satisfaction: How satisfied were you with the way you and hospital staff were able to communicate?; provider (physician, triage nurse, and discharge nurse) satisfaction: How satisfied are you that language issues were adequately addressed to assess and treat this patient's condition?