HSR Health Services Research

DOI: 10.1111/j.1475-6773.2011.01329.x
SPECIAL ISSUE: BRIDGING THE GAP BETWEEN RESEARCH AND HEALTH POLICY-INSIGHTS FROM ROBERT WOOD JOHNSON FOUNDATION CLINICAL SCHOLARS PROGRAM

Does a Video-Interpreting Network Improve Delivery of Care in the Emergency Department?

Elizabeth A. Jacobs, Paul C. Fu Jr., and Paul J. Rathouz

Objective. To measure the impact of a policy change from use of telephonic and face-to-face interpreting to use of a video-interpreting network on Emergency Department (ED) care.

Data Sources/Study Setting. Observational study of ED care at two California hospitals.

Study Design. We compared tests ordered, time in the ED, and admission rates for English- and Spanish-speaking patients presenting with chest pain and abdominal pain before and after the policy change.

Data Collection/Extraction Methods. Data were extracted from electronic medical and billing records.

Principal Findings. Mean time in the ED, mean number of laboratory tests, radiology services, electrocardiograms, and echocardiograms, and rates of hospital admission for both language groups at both hospitals went down in the post-video-interpreting network period compared with the pre-video-interpreting network period. The percentage of patients leaving the ED against medical advice (AMA) increased in one hospital for both language groups; this increase was statistically significantly smaller in the Spanish-language group compared with the English group ($p = .04$).

Conclusions. The studied video-interpreting network had minimal impact on health care outcomes in the ED.

Key Words. Interpreters, language barriers, Emergency Department, policy, safety net

More than 46 million people in the United States do not speak English as their primary language and more than 21 million speak English less than "very well" (U.S. Census Bureau 2000). Many of these limited English proficient (LEP) residents face language barriers to access to medical care (Rader 1988; Association of State and Territorial Offices 1992; Anonymous 1995; Ginsberg et al. 1995; Schmidt, Ahart, and Schur 1995; Woloshin et al. 1995; Baker et al. 1996; Hablamos Juntos 2001). Title VI of the Civil Rights Act states that people cannot be discriminated against as a result of their national origin, which has been interpreted by the Federal courts to include discriminating against an individual whose primary language is not English (Department of Justice 1964). Consequently, and as directed by Federal Guidance, health care organizations receiving Federal funds, which most do in the form of Medicaid or Medicare, must provide services in a language that an LEP patient can understand (Clinton 2000). Because of the dearth of health care providers who are proficient in languages other than English, these patients and their clinicians must rely on interpreters to reduce these barriers. Untrained ad hoc interpreters, such as family and friends, have been documented to provide substandard communication assistance, so provision of professional health care interpretation is the model in the United States (Karliner et al. 2007). However, it is not clear how best to provide these services and what policies should be in place regarding how and when they are delivered.

To date, most interpretation in health care has been provided by professional face-to-face and telephonic interpreters. Face-to-face interpretation allows interpreters to use visual clues to aid in their role but can be an inefficient means of service delivery because time interpreting is lost in transit between clinical sites and waiting for providers and patients. Telephonic interpretation increases efficiency of service delivery, but it has the disadvantage of loss of interpreter visual clues and rapport development with patient and provider. A new means of interpreting—video-interpreting over the Internet—is billed as an efficient means of delivering professional interpreting service within minutes with use of a video monitor so that patient, provider, and interpreter can all see one another (Paras and Associates Interpreter Systems 2009). Like telephonic interpreting, this model also allows for a shared network of geographically distant interpreters that can increase the interpreter pool and service capacity over a large geographic area (Paras and Associates Interpreter Systems 2009). While this model seems advantageous, little

Address correspondence to Elizabeth A. Jacobs, M.D., M.P.P., Associate Professor and Associate Vice Chair for Health Services Research, Department of Medicine, University of Wisconsin School of Medicine and Public Health, 800 University Bay Drive, Suite 210, Madison, WI 53705; e-mail: eajacobs@medicine.wisc.edu. Paul C. Fu, Jr., M.D., M.P.H., is with the David Geffen School of Medicine at UCLA and UCLA School of Public Health, Harbor-UCLA Medical Center, Los Angeles Biomedical Research Institute, Torrance, CA. Paul J. Rathouz, Ph.D., is with the Department of Biostatistics & Medical Informatics, University of Wisconsin School of Medicine and Public Health, Madison, WI.

research has been conducted to evaluate the impact or effectiveness of providing health care interpretation using this model.

The objective of this large observational study was to measure the impact of a policy change from minimal solo use of telephonic and face-to-face interpreting to use of video-interpreting within a network of public hospitals. Specifically, we compared mean number of tests ordered, mean time in the ED, and admission rates for LEP patients with chest pain and abdominal pain before and after the implementation of a network of telephonic and video interpreting services at two of the network institutions. While some face-to-face and telephonic interpreters were available at these two institutions prior to the implementation of the video network, the intervention dramatically increased access to professional interpreter services within a minute or less of request. While there are many ways in which the intervention could have impacted communication, we chose to look at test ordering, mean time in the ED, and admission rates. We chose these measures based on our hypotheses that when able to readily access interpreters to speak with LEP patients via the video-interpreting network, the ED clinicians would feel less need to rely on test ordering and time in the ED for diagnosis and evaluation and that admission to the hospital would be reduced as the physician would feel more comfortable that instructions and follow-up appointments would be understood by the patient upon discharge home. We chose the ED for this study, as it is known that interpreter services are in great demand in the ED setting and not always readily accessible, important outcomes can be measured for within the context of one visit, and the relationship between language barriers and increased diagnostic testing has been previously documented in the setting of the ED (Baker et al. 1996; Hampers et al. 1999; Hampers and McNulty 2002; Ramirez, Engel, and Tang 2008; Ginde, Clark, and Camargo 2009).

METHODS

Video-Interpreting Network

We studied a large system of shared remote interpreter services organized in a collaborative network of 14 public and nonprofit hospitals in California with technical support from a private company, Paras and Associates. Health care professionals at each of the participating hospitals use interpreters at their own hospital or at their partner hospitals via videoconferencing or telephone. Each hospital employs interpreters that provide services over a video network. As a result, Paras and Associates has documented that the partnership enhances the efficiency of interpreter use by distributing the resources across the network, making services available 24 hours a day and within minutes at any of the participating hospitals in the network, and increasing access to interpreter services at participating hospitals (Paras and Associates, personal communication). Of note, Paras and Associates did not provide any of the data used in this study, nor did they direct or participate in the analysis, interpretation of results, or writing of the manuscript.

Observational Study Design

We compared the provision of care to patients being seen in the ED of two of the network hospitals in California (Hospital A, in a rural area in Northern California, and Hospital B, in an urban area in Southern California), before and after implementation of the video-network services. Due to funding and time limitations, we were only able to study two of the network hospitals. We chose these hospitals because they represent geographically different areas of California, they are similar in size and mission; had established, efficient video-network service delivery at the time of the study; and had expertise in abstracting the type of data we needed for the study. At each location, we studied the same 6-month period in the year before and the year after implementation of the interpreter video network to isolate any seasonal effect on presentation to the ED. To increase the likelihood that the video-network services were at maximal use in the ED during the study period, we used post-implementation data only after the services had been in place for 6 months. To try to isolate the impact of the video-network on our chosen outcomes from the underlying disease process, we limited our analysis to patients being seen in the ED for abdominal or chest pain. These diagnoses are common in the ED and are frequently caused by benign conditions, and they also may indicate a serious issue such as heart attack or appendicitis; therefore, if physicians feel that they cannot take an adequate history, they may rely on expensive testing to rule out more serious etiologies. The study was approved by the Cook County Health and Hospital System's institutional review board (IRB) and the IRBs of both study hospitals.

Sample

We used International Statistical Classification of Diseases and Related Health Problems (ICD-9) codes for ED billing to identify adult ED patients who were evaluated for conditions that typically cause chest pain (73 codes) or abdominal pain (121 codes). We identified these codes using electronic ICD-9 libraries. We included only English and Spanish speakers in our study sample. We limited our LEP analysis to Spanish-speaking patients only because a vast majority of LEP patients seen at both study hospitals were Spanish-speaking and the numbers in the other language groups were too small to provide stable statistical estimates of the impact of the video-network services on care. The purpose of the English-speaking group was to control for trends in changes in service over time that were unrelated to the implementation of the video-network services.

Measures and Data Sources

Data were abstracted from the study hospitals' electronic health record (EHR) and billing systems. Data abstracted from the EHR included the patient's primary language (from the primary language field), gender (male/female), age (entered as a continuous variable), insurance type (Medicaid, Medicare, private, uninsured), length of stay in the ED (minutes from being brought into an ED evaluation room to admission or discharge), and whether the patient was admitted to the hospital, was discharged home, or left against medical advice (AMA) (all treated as dichotomous variables). Data abstracted from the billing records included number of ICD-9 diagnoses at discharge (used as a continuous variable to control for co-morbidity and medical complexity), and number of radiology tests, laboratory tests, electrocardiograms (EKGs), and echocardiograms billed for during the ED stay (all continous variables). Hospital B has documented the validity of this data through an established quality improvement process in which 1 percent of charts are regularly audited for review and validation of language, diagnosis, and procedure data.

There were very little missing data. Data were never missing for primary language, and the few individuals whose sex or age was unknown (n = 12) were dropped from the analysis. All other data were left as missing and those individuals dropped by the analytic software (*STATA 10.0*, College Station, TX, United States) when those items were included in the analysis.

Statistical Analyses

As the study hospitals differ in the populations they serve and in patterns of health care utilization, we analyzed data from each one separately. Within each hospital, we conducted chi-square tests and two-sample t-tests to evaluate whether there were differences in patient diagnoses, sociodemographic characteristics, time in the ED, admission rates, and tests ordered before and after implementation of video-network services for each language group. We then conducted linear and logistic multivariate regression analyses to evaluate the differences in mean time in the ED, number of tests ordered, and odds of admission before and after implementation of interpreter services for English- and Spanish-speaking patients. These analyses all controlled for gender, age, number of ICD-9 diagnoses at discharge, and insurance type. In adjusted multivariate analyses, we then compared whether the pre-/post-video-network change in each study outcome for Spanish-speaking patients was significantly different from the pre-/post-video-network change for the same variable in the English-speaking patients.

RESULTS

Sample sizes and descriptive information for pre- and post-video-network sample and for English and Spanish speakers at each study hospital are given in Table 1. In all samples, Spanish speakers were more likely to be male, older, and to be insured by Medicaid.

Unadjusted results for change in care before and after implementation of the video-network interpreting services are shown in Table 2. As results did not differ by diagnosis, we present combined results for both diagnoses. Mean time in the ED for both language groups at both hospitals went down in the post-video-interpreting network time period compared with the pre-video-interpreting network time period, by 16 minutes for English speakers and 31 minutes for Spanish speakers at Hospital A, and by 34 and 87 minutes for these two groups, respectively, at Hospital B. The greater reduction in ED time for Spanish speakers was not statistically significantly different from English speakers at either hospital. Compared with the pre-video-network time period, the mean number of post-video-network laboratory and radiology tests, EKGs, and echocardiograms fell for both language groups at both hospitals. However, there was no significant difference in the reduction of tests performed in the Spanish-speaking group compared with the English-speaking group at either hospital. Adjustment for gender, age, number of ICD-9 diagnoses at discharge, and insurance type did not change these results.

Unadjusted results are similar for the admission data. The percentage of ED patients admitted to the hospital went down in the post-video-network time period for both language groups at Hospital A and was essentially unchanged for both language groups at Hospital B. Again, there was no significant difference in the change in admission rates for English speakers compared with Spanish speakers at either study hospital. The percentage of

Table 1: Demographic Characteristics of Study Samples from Each Hospital before and after Implementation of Video-Network Interpreter Services (VN)

	Hospital A			
	English Speakers		*Spanish Speakers*	
	Pre-VN (n = 2,850)	*Post-VN (n = 3,957)*	*Pre-VN (n = 1,727)*	*Post-VN (n = 2,454)*
Male (*n*, %)	1,426 (50%)	2,084 (54%)	1,071 (62%)	1,588 (65%)
Age (years ± SD)	48.3 (16.1)	45.6 (16.0)	50.8 (16.2)	49.7 (15.4)
Insurance status				
Medicaid (*n*, %)	836 (29%)	1,012 (26%)	801 (46%)	969 (39%)
Medicare (*n*, %)	357 (12%)	346 (9%)	101 (6%)	122 (5%)
Private (*n*, %)	321 (11%)	458 (12%)	80 (5%)	137 (6%)
Uninsured (*n*, %)	1,335 (47%)	2,141 (54%)	745 (43%)	1,226 (50%)
Diagnoses at discharge				
Only abdominal pain (*n*, %)	935 (33%)	1,321 (33%)	689 (40%)	1,029 (42%)
Only chest pain (*n*, %)	1206 (42%)	1,873 (47%)	667 (39%)	1,021 (42%)
Both abdominal and chest pain (*n*, %)	709 (25%)	763 (19%)	371 (21%)	404 (16%)
Median no. of diagnoses	3	3	3	3
	Hospital B			
	English Speakers		*Spanish Speakers*	
	Pre-VN (n = 2,767)	*Post-VN (n = 2,781)*	*Pre-VN (n = 734)*	*Post-VN (n = 681)*
Male (*n*, %)	1,515 (55%)	1,500 (54%)	429 (58%)	429 (63%)
Age (years ± SD)	44.1 (15.6)	43.2 (15.5)	43.2 (17.7)	43.7 (17.5)
Insurance status				
Medicaid (*n*, %)	1,177 (43%)	1,377 (50%)	323 (44%)	334 (49%)

continued

Table 1. *Continued*

	Hospital B			
	English Speakers		Spanish Speakers	
	Pre-VN (n = 2,767)	*Post-VN (n = 2,781)*	*Pre-VN (n = 734)*	*Post-VN (n = 681)*
Medicare (*n*, %)	375 (14%)	330 (12%)	75 (10%)	56 (8%)
Private (*n*, %)	92 (3%)	69 (2%)	14 (2%)	9 (1%)
Uninsured (*n*, %)	1,123 (41%)	1,005 (36%)	322 (44%)	282 (41%)
Diagnoses at discharge				
Only abdominal pain (*n*, %)	1,229 (44%)	1,228 (44%)	370 (50%)	356 (52%)
Only chest pain (*n*, %)	1,180 (43%)	1,261 (45%)	281 (38%)	256 (38%)
Both abdominal and chest pain (*n*, %)	358 (13%)	292 (11%)	83 (11%)	69 (10%)
Median no. of diagnoses	2	2	2	2

Table 2: Use of Care in Study Hospital Emergency Departments before and after Implementation of Video-Network Interpreter Services (VN)

	Hospital A			
	English Speakers		*Spanish Speakers*	
	Pre-VN (n = 2,850)	*Post-VN (n = 3,957)*	*Pre-VN (n = 1,727)*	*Post-VN (n = 2,454)*
Time in ED (mean)	601 minutes	585 minutes	728 minutes	697 minutes
Laboratory tests (mean)	42.2	31.5	38.1	29.1
Radiology tests (mean)	3.1	2.5	2.9	2.2
EKGs (mean)	3.5	2.9	3.0	2.6
Echocardiograms (mean)	0.4	0.3	0.3	0.2
Admissions (*n*, %)	1,545 (59%)	1,681 (44%)	856 (50%)	954 (39%)
Left against medical advice (*n*, %)	38 (1.33%)	239 (6.0%)	24 (1.4%)	88 (3.6%)*
	Hospital B			
	English Speakers		*Spanish Speakers*	
	Pre-VN (n = 2,767)	*Post-VN (n = 2,781)*	*Pre-VN (n = 734)*	*Post-VN (n = 681)*
Time in ED (mean)	606 minutes	532 minutes	680 minutes	573 minutes
Laboratory tests (mean)	2.8	2.9	2.9	2.8
Radiology tests (mean)	0.6	0.6	0.7	0.6
EKGs (mean)	0.3	0.3	0.3	0.2
Echocardiograms (mean)	0	0	0	0
Admissions (*n*, %)	520 (19%)	476 (17%)	111 (15%)	110 (16%)
Left against medical advice (*n*, %)	298 (11%)	298 (11%)	50 (8%)	57 (8%)

*p = .04.

patients leaving the ED AMA increased at Hospital A for both language groups; this increase was statistically significantly smaller in the Spanish-language group compared with the English group ($p = .04$). Rates of leaving the ED AMA were stable at Hospital B. Adjustment for gender, age, number of ICD-9 diagnoses at discharge, and insurance type did not change these results.

DISCUSSION

While our data suggest that a policy change to use of a large interpreter video network from traditional face-to-face and telephonic interpreting model may have contributed to reducing the time Spanish speakers spent in the ED, we were unable to show a statistically significant impact of this change on care in the Emergency Department. We did find, however, that the risk of patients leaving the ED before receiving appropriate care was significantly reduced among Spanish speakers, compared with English speakers, after the implementation of the video-interpreting network in one of our study hospitals.

Other studies of the impact of the provision of professional interpreter services on ED care have found somewhat more consistently positive results. Hampers and McNulty (2002) documented a reduction in resource utilization, cost, and rates of admission to the hospital when professional interpreters are employed in a pediatric ED (Hampers and McNulty 2002). Bernstein et al. (2002) showed that patients who received interpreter services in a Boston ED were comparable to English-speaking patients in LOS, testing, and procedure completion. In addition, interpreted patients in this same study had higher adherence to primary care and specialty-clinic referrals than either of the other two groups (Bernstein et al. 2002). We may not have found similar results because of differences in region of the country and study population or because this was a large observational study in which we examined what happened to Spanish speakers at the population level, not just those known to get services via the video-interpreting network.

We also may not have found the results we expected because our outcome measures were not as dependent on communication as we had hypothesized. Given the nature of ED practice (established practice patterns, protocols, malpractice avoidance, admission bed flow issues, etc.), there are many other factors that influence our outcomes that probably had a stronger influence on what happens in the ED than accurate communication between clinician and patient. Clearly, our measures were based on hypotheses about how the video network would enhance physician understanding in their communication with patients. In hindsight, we may have found a more significant impact if we examined measures that were dependent on the patient's understanding, such as comprehension and adherence to communicated follow-up. This idea is supported by one of the previous studies that found interpretation did significantly impact likelihood of following up on recommended outpatient referrals and reduce return to the ED (Bernstein et al. 2002).

While possible, it is unlikely that the mode of interpretation delivery, via video-interpreting, contributed to our finding less impact than we expected. Our study appears to be the first to evaluate the impact of a shift to video-interpreting on care outcomes. We identified three other studies of interpreter services delivered via video, all of which compared some measure of patient and provider satisfaction with video-interpreting to in-person and telephonic interpreting (Jones et al. 2003; Locatis et al. 2010; Napoles et al. 2010). In all three, encounters in which interpretation was provided via video were rated as high or in some cases higher than the other methods of providing interpreter services. Clearly, this is an acceptable method of interpretation.

Our study has several limitations. First, this was a natural experiment in which we measured the global impact of a change in policy to use video-network interpreter services on health care. We were not able to measure who actually received interpretation via this network. It may be that we would have been able to demonstrate an impact on care in those individuals for whom we could document use of these services. Alternatively, it may be that the ED clinical staff did not choose to use the services. However, we have data that suggest that there was a rapid increase in use of the interpreter services in the ED after implementation of the video network (Paras and Associates, personal communication). More likely is the fact that there are many other factors that influence our outcomes, as previously mentioned, that may have a stronger influence on what happens in the ED than accurate communication between clinician and patient. In addition, there are limitations to using EHR and billing data. As the language, age, and gender data were recorded by clerks/administrative staff for operational rather than research purposes, the data may be inaccurate or incomplete; however, the data were documented to be of high quality in one of the study hospitals. In addition, using ICD-9 codes to identify patients presenting to the ED with chest and/or abdominal pain may not have captured all patients entering the ED with this complaint or led to the inclusion of patients with other initial complaints. Given that the same EHR and billing data and set of ICD-9 codes were used in each hospital, for both English and Spanish speakers, in the period before and after the implementation of the video-interpreting services, it is unlikely that this biased our comparative analysis.

Finally, just because we did not demonstrate a statistically significant impact of a policy shift to provision of interpreter services via a video network on our six outcomes, it does not mean that they have not had a significant impact on the hospitals, clinicians, and patients that used them. Administrators, clinicians, and patients recognize that interpreter services, and their efficient provision through the video network studied, have inherent value and moral weight. Policy makers do as well, as demonstrated by the development and dissemination of both Federal and state policy directing that interpreter services be provided to LEP patients (Department of Justice 1964; Clinton 2000; Onecle.com 2006). Timely, accurate, and unburdened communication is a universal need in health care, and LEP patients are at the greatest risk of not being able to participate in, consent to, and understand their health care interactions. Provision of interpreter services through a video network may be one method for reducing these barriers and making sure that patients who seek care in a hospital will receive the standard of care—communication in a language they can understand.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: This research could not have been conducted without the assistance of Melinda Paras of Paras & Associates, Frank Puglisi of the Health Care Interpreting Network, Barbara Hill of San Joaquin General Hospital, Lilly K. Maeoka of Keane, Inc., and David O'Neill of The California HealthCare Foundation. This work was supported by a grant from The California HealthCare Foundation. The findings have been presented at the "Healthcare Interpreting–From Face-to-Face to Cyberspace" meeting from March 18th to 20th, 2009 in Santa Ana, California, and the Communication in Medicine and Ethics meeting, from June 27th to 30th, 2010 in Boston, MA.

Disclosures: None.

Disclaimers: None.

REFERENCES

Anonymous. 1995. "Need for Interpreter/Translation Services Critical in Hospitals and Other Clinical Settings." *Health Care Strategic Management* 13 (6): 15.

Association of State and Territorial Offices. 1992. *ASTHO Bilingual Health Initiatives: Report and Recommendations.* Washington, DC: Office of Minority Health.

Baker, D. W., R. M. Parker, M. V. Williams, W. C. Coates, and K. Pitkin. 1996. "Use and Effectiveness of Interpreters in an Emergency Department." *Journal of the American Medical Association* 275 (10): 783–8.

Bernstein, J., E. Bernstein, A. Dave, E. Hardt, T. James, J. Linden, P. Mitchell, T. Oishi, and C. Safi. 2002. "Trained Medical Interpreters in the Emergency Department: Effects on Services, Subsequent Charges, and Follow-up." *Journal of Immigrant Health* 4 (4): 171–6.

Clinton, W. 2000. *Executive Order 13166—Improving Access to Services for Persons with Limited English Proficiency*, p 6. Washington, DC: Federal Register.

Department of Justice. 1964. "Title VI of the Civil Rights Act of 1964" [accessed on December 17, 1964]. Available at http://www.usdoj.gov/crt/cor/coord/titlevi.php.

Ginde, A. A., S. Clark, and C. A. Camargo Jr. 2009. "Language Barriers among Patients in Boston Emergency Departments: Use of Medical Interpreters after Passage of Interpreter Legislation." *Journal of Immigrant and Minority Health* 11 (6): 527–30.

Ginsberg, C., D. Martin, D. Andrulis, Y. Shaw-Taylor, and C. McGregor. 1995. *Interpretation and Translation Services in Health Care: A Survey of US Public and Private Teaching Hospitals.* Washington, DC: National Public Health and Hospital Institute.

Hablamos Juntos. 2001. "Press Release: New Survey Shows Language Barriers Causing Many Spanish-speaking Latinos to Skip Care" [accessed on August 22, 2001]. Available at http://www.hablamosjuntos.org/mediacenter/pressreleases/default.12122001.asp.

Hampers, L. C., S. Cha, D. J. Gutglass, H. J. Binns, and S. E. Krug. 1999. "Language Barriers and Resource Utilization in a Pediatric Emergency Department." *Pediatrics* 103 (6 Pt 1): 1253–6.

Hampers, L. C., and J. E. McNulty. 2002. "Professional Interpreters and Bilingual Physicians in a Pediatric Emergency Department: Effect on Resource Utilization." *Archives of Pediatrics & Adolescent Medicine* 156 (11): 1108–13.

Jones, D., P. Gill, R. Harrison, R. Meakin, and P. Wallace. 2003. "An Exploratory Study of Language Interpretation Services Provided by Videoconferencing." *Journal of Telemedicine and Telecare* 9 (1): 51–6.

Karliner, L. S., E. A. Jacobs, A. H. Chen, and S. Mutha. 2007. "Do Professional Interpreters Improve Clinical Care for Patients with Limited English Proficiency? A Systematic Review of the Literature." *Health Services Research* 42 (2): 727–54.

Locatis, C., D. Williamson, C. Gould-Kabler, L. Zone-Smith, I. Detzler, J. Roberson, R. Maisiak, and M. Ackerman. 2010. "Comparing in-Person, Video, and Telephonic Medical Interpretation." *Journal of General Internal Medicine* 25 (4): 345–50.

Napoles, A. M., J. Santoyo-Olsson, L. S. Karliner, H. O'Brien, S. E. Gregorich, and E. J. Perez-Stable. 2010. "Clinician Ratings of Interpreter Mediated Visits in Underserved Primary Care Settings with Ad Hoc, in-Person Professional, and Video

Conferencing Modes." *Journal of Health Care for the Poor and Underserved* 21 (1): 301–17.

Onecle.com. 2006. "California Health and Safety Code Section 1367.04" [accessed on December 17, 2006]. Available at http://law.onecle.com/california/health/1367.04.html.

Paras and Associates Interpreter Systems. 2009. "ALVIN - All Language Video Interpreter Network: How It Works" [accessed on July 12, 2009]. Available at http://www.parasandassociates.net/how_it_works.html.

Rader, G. S.. 1988. "Management Decisions: Do We Really Need Interpreters?" *Nursing Management* 19 (7): 46–8.

Ramirez, D., K. G. Engel, and T. S. Tang. 2008. "Language Interpreter Utilization in the Emergency Department Setting: A Clinical Review." *Journal of Health Care for the Poor and Underserved* 19 (2): 352–62.

Schmidt, R., A. Ahart, and G. Schur. 1995. *Limited English Proficiency as a Barrier to Health and Social Services.* Washington, DC: Macro International, Inc.

U.S. Census Bureau. 2000. "DP-2. Profile of Selected Social Characteristics: 2000" [accessed on December 17, 2000]. Available at http://factfinder.census.gov/servlet/QTTable?_bm=y&-state=qt&-qr_name=DEC_2000_SF3_U_DP2&-ds_name=DEC_2000_SF3_U&-CONTEXT=qt&-redoLog=false&-_caller=geoselect&-geo_id=04000US18&-geo_id=NBSP&-format=&-_lang=en.

Woloshin, S., N. A. Bickell, L. M. Schwartz, F. Gany, and H. G. Welch. 1995. "Language Barriers in Medicine in the United States." *Journal of the American Medical Association* 273 (9): 724–8.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.