Implications of Language Barriers for Healthcare: A Systematic Review

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ABSTRACT
Objectives: Language barriers pose challenges in terms of achieving high levels of satisfaction among medical professionals and patients, providing high-quality healthcare and maintaining patient safety. To address these challenges, many larger healthcare institutions offer interpreter services to improve healthcare access, patient satisfaction, and communication. However, these services increase the cost and duration of treatment. The purpose of this review is to investigate the impact of language barriers on healthcare and to suggest solutions to address the challenges.

Methods: We identified published studies on the implications of language barriers in healthcare using two databases: PubMed and Medline. We included 14 studies that met the selection criteria. These studies were conducted in various countries, both developed and developing, though most came from the US. The 14 studies included 300,918 total participants, with participation in each study ranging from 21 to 22,353 people.

Results: We found that language barriers in healthcare lead to miscommunication between the medical professional and patient, reducing both parties’ satisfaction and decreasing the quality of healthcare delivery and patient safety. In addition, the review found that interpreter services contribute indirectly to increased cost and the length of treatment visits. One study reported the implementation of online translation tools such as Google Translate and MediBabble in hospitals, which increased the satisfaction of both medical providers and patients (to 92%) and improved the quality of healthcare delivery and patient safety. Language barriers are responsible for reducing the satisfaction of medical providers and patients, as well as the quality of healthcare delivery and patient safety. Many healthcare institutions use interpreter services that increase the cost and length of treatment visits.

Conclusions: The results of our review suggest that implementing online translation tools such as Google Translate and MediBabble may improve the quality of healthcare and the level of satisfaction among both medical providers and patients.

Language barriers have a major impact on the cost and quality of healthcare. They commonly occur between healthcare providers and patients when the two groups do not share a native language.1 Regardless of language barriers, healthcare providers are required to deliver high-quality healthcare that adheres to the principles of human rights and equity to all their patients.2

Health disparities such as unequal treatment related to language barriers are associated with unequal access to healthcare and unequal health outcomes.3 For instance, a recent study demonstrated that patients who do not speak the local language are disadvantaged in terms of access to healthcare services.4 Similarly, several studies have shown that patients who face language barriers have poorer health outcomes compared with patients who speak the local language.5,6

Growing evidence documents the fact that language barriers indirectly impact the quality of the healthcare that patients receive. Language barriers contribute to reducing both patient and medical provider satisfaction, as well as communication.
between medical providers and patients. Patients who face language barriers are more likely to consume more healthcare services and experience more adverse events. A recent study conducted in six hospitals in the US found that adverse events occurred more frequently among patients with limited proficiency in English than among those who were proficient in English.

This review investigates the impact of language barriers on healthcare and suggests solutions to address the challenges.

**METHODS**

We identified studies of the impact of language barriers on the delivery of healthcare by searching the PubMed and Medline databases using the keywords: 'language barriers,' 'satisfaction,' 'healthcare,' 'limited English proficiency,' 'quality of care,' 'communication,' and 'access to health services.'

This review includes studies that address the impact of language barriers on the delivery of healthcare. It excludes studies into the impacts of communication barriers other than language barriers on the delivery of healthcare, studies that were not primarily conducted in healthcare organizations, and non-peer-reviewed articles. The search strategy was limited to articles published from 2000 to 2019 to find the most recent literature on the topic.

The extracted data are summarized in two tables. Table 1 outlines the general characteristics of the studies, including the country in which the study was conducted.

| Author          | Country       | Number of organizations | Type of organization | Study type          | Data collection                  | Sample size | Response, % |
|-----------------|---------------|-------------------------|----------------------|---------------------|----------------------------------|-------------|-------------|
| Albrecht et al. | Germany       | Hospital                | MOH                  | Cross-sectional     | Questionnaire                    | 39          | 90.0        |
| Al-Khathami et al | Saudi Arabia  | One medical city        | MOH                  | Cross-sectional     | Interview                        | 116         | 100         |
| Bagchi et al.   | USA           | Medicaid program        | NA                   | NA                  | Medicaid records                 | 22,353      | 100         |
| Bischoff et al. | Switzerland   | Five health centers     | MOH                  | Cross-sectional     | Hospital database                | 795         | 61.1        |
| Bischoff et al. | Switzerland   | Four health centers     | MOH                  | Cross-sectional     | Interview                        | 723         | 100         |
| de Moissac et al | Canada        | NA                      | MOH                  | Cross-sectional     | Online questionnaire and telephone interview | 297        | 100         |
| Divi et al.     | USA           | Six hospitals           | MOH                  | Prospective study   | Incident reports                 | 1083        | 74.0        |
| Kale et al.     | Norway        | All health centers in three cities | MOH                  | Cross-sectional     | Questionnaire                    | 1290        | 35.1        |
| Ngo-Metger et al| USA           | Eleven health centers   | MOH                  | Cross-sectional     | Mailed survey                    | 2746        | 74.0        |
| Pytel et al.    | USA           | Tertiary health care center | MOH                  | Prospective study   | Questionnaire                    | 123 patients/ visitors and 73 nurses | 100        |
| Schlemmer et al.| South Africa  | One hospital            | MOH                  | Cross-sectional     | Interview                        | 21 health staff (6 junior doctors, 8 experienced nurses, 7 staff) and 5 patients | 100        |
| Van Rooyen et al | Saudi Arabia  | NA                      | MOH and private      | Qualitative research | Interview                        | NA          | NA          |
| Wilson et al.   | USA           | NA                      | NA                   | Cross-sectional     | Telephone survey                 | 1200        | NR          |

*MOH: Ministry of Health; NA: not applicable; NR: not recorded.*
## Table 2: The important findings from the 14 studies identified.

| Author                  | Focus                                                                 | Results                                                                                                                                                                                                 |
|-------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Albrecht et al.         | Online translation tools                                             | In case of reducing the cost of care (interpreter services), Google Translate and MediBabble application used in health organizations. Participants stated:  
- Free and easy to access (92%).  
- Saves time at the visit (92%).  
- Improves health care delivery and patient safety (92%). |
| Ali et al.              | Impact on the provision of care                                       | Limited English proficient patients (LEPPs) reported they had missing appointments and difficulties in arranging appointments because of language barriers. |
| Al-Khathami et al.      | Patients satisfaction with the health services delivered by non-Arabic speakers (nurses) | The overall satisfaction of patients about nurse’s care was 90%. Whereas, patients reported they had a concern about language barriers while delivering health care. Patients reported the following:  
- 30% of patients have difficulties in understanding the instructions of non-Arabic speaking nurses (NASNs).  
- 30% have a problem with the reliability of the information delivered by NASNs.  
- 50% believed that the language barrier is contributed to more susceptible to error.  
- 50% avoid and 70% end conversation.  
- 40% called for an interpreter. |
| Bagchi et al.           | Cost of interpretation services for Medicaid recipients              | Non-English-speaking patients who used the interpreter services received more inpatient services and office visits. Providing interpreter services for Medicaid recipients was estimated at $ 4.7 million annually. |
| Bischoff et al.         | Cost of health care                                                  | - 26.4% of LEPPs reported no interpreter.  
- LEPPs increased the cost of health care indirectly by using an interpreter. |
| Bischoff et al.         | Asylum seekers and refugees                                          | - 11% of nurses reported poor communication with asylum seekers.  
- 76% of nurses stated there was no interpreter support when they need. |
| de Moissac et al.       | Patient satisfaction                                                 | The language barrier caused:  
- 66.7% of LEPPs reported that they had a barrier to accessing healthcare.  
- 20% of LEPPs indicated that not seeking health care services if these were not available for fear of not understanding.  
- 70.7% of LEPPs reported that the limited availability of interpreter services.  
- Increased stress and decreased confidence that health care service received were appropriate. |
| Divi et al.             | Adverse events and patient satisfaction                              | LEPPs had adverse events, which resulted in:  
- Detectable physical harm (49.1% of LEPPs).  
- Moderate temporary harm or worse (46.8%).  
- Some failure in communication (52.4%). |
| Kale et al.             | Cultural communication in health and health provider satisfaction    |  
- 30% of health providers reported that they used interpreters daily because of the large immigrant patient population.  
- Physicians and nurses reported that they need for interpreters with 43.2% and 36.5% cases (who understand of Norwegian is insufficient), respectively.  
- 21% of health providers stated that there was poor access to interpreter services.  
- 37% of physicians reported they felt that patients hide some information because of the language barrier. |
| Ngo-Metzger et al.      | Quality of interpersonal care                                        | Patients with language-discordant providers reported receiving worse interpersonal care and less health education. |
| Pytel et al.            | Communication and patient satisfaction                               | About 89% of patients reported that nurses speak in a way that meets their language needs, and that is an important item for communication needs. Whereas, 94.3% of nurses reported that it is very important for work and communication environments to understand the language of patients. |
| Schlemmer et al.        | Language barrier on health workers and patients                       | Patients had poor satisfaction with care due to language barrier. Doctors did not understand patients who speak a different language, leading to wrong diagnosis and medication. |
| Van Rooyen et al.       | South African (SA) nurses’ satisfaction                              | SA nurses had communication barriers:  
- They had a big challenge of communication with patients and their family members because of the language barriers.  
- SA nurses were not interested in learning the Arabic language, but know a few words just for simple communication.  
- SA nurses had some difficulty in speaking with other nurses from other countries because their English speaking was in some way different. |
| Wilson et al.           | Adverse medication and patient satisfaction                           | LEPPs had problems with medical comprehension, which resulted in:  
- Problem understanding a medical situation (49%).  
- Confused about how to use medication (34.7%).  
- Trouble understanding the label on the medication (41.8%).  
- Bad reaction to medication due to problem understanding instructions (15.8%). |
done, the total number of organizations in which the sample was collected, the type of organization that conducted the study, the study type, the data collection method, the sample size, and the response rate. Table 2 presents the implication of language barriers on the delivery of healthcare in each study in the review.

**RESULTS**

Figure 1 shows the researcher’s method of selecting eligible studies for this review. Initially, the researcher’s search of the PubMed and Medline databases returned 2569 articles. After removing the duplicate articles, 1211 remained. Next, the researcher excluded the articles that were not mainly about language barriers \( (n = 605) \) and the non-peer-reviewed articles \( (n = 532) \). Then the researcher excluded those studies that were not primarily conducted in healthcare organizations \( (n = 60) \), leaving 14 articles to be included in this systematic review.

Table 1 presents a summary of the general characteristics of the 14 studies arranged by the authors’ names. Nine studies used a cross-sectional design, two used a prospective design, two used qualitative research, and one was a report. Five studies collected data from an interview survey, three used questionnaires, one used both an interview survey and questionnaires, three used hospital databases, and two used telephone and mail surveys. Five of the studies were conducted in the US, two in Saudi Arabia, two in Switzerland, and one each in Canada, Germany, England, Norway, and South Africa. The total number of participants in the 14 studies was 300,918, with the number of participants in each study ranging from 21 to 22,353.

Table 2 presents the most important findings of the 14 studies in this review. Seven of the studies focused on language barriers and patient satisfaction, two on the impact of language barriers on healthcare provider satisfaction, one on the impact of language barriers on both healthcare providers and patient satisfaction, two on the cost of interpretation services, one on the quality of interpretation services, and one on online translation tools. The findings of studies can be divided into three categories: the impact of language barriers on medical providers (such as physicians and nurses), patients, and the cost and quality of healthcare services.

Communication between patients and medical providers is at the heart of effective healthcare. In Pytel,\(^\text{17}\) 94.3% of nurses reported that it was very important for their work environment and communication to understand the language of their patients. Physicians also have difficulty understanding patients who do not speak their language, leading to wrong diagnosis and medications.\(^\text{18}\) In Norway, medical providers reported that they had trouble understanding between 36% and 43% of the patients who do not speak the local language, necessitating interpreters.\(^\text{15}\) Indeed, 37% of physicians indicated that they felt that patients hide some information because of language barriers.\(^\text{13}\) In addition, all South African nurses in Saudi Arabia had difficulty communicating with patients and their family members, as well as nurses from other countries, because of language barriers.\(^\text{19}\)

Language barriers have negative implications for the delivery of healthcare and patient satisfaction. One study showed that among patients who received treatment from nurses who did not speak the local language, 30% had difficulty understanding medical instructions, 30% had a problem with the reliability of information, and 50% believed that the language barrier contributed to errors.\(^\text{10}\) Other studies found that among patients who did not speak the local language, 49% had trouble understanding a medical situation, 34.7% were confused about how to use medication, 41.8% had trouble understanding a
label on medication, 15.8% had a bad reaction to medication due to a problem understanding their healthcare provider’s instructions,20 66.7% faced a barrier when accessing healthcare, and 20% did not seek healthcare services if these were not readily available for fear of not understanding their healthcare provider.14 Furthermore, many patients with limited local language proficiency experienced adverse health events that resulted in detectable physical harm (49.1% of patients) or moderate temporary harm (46.8%) or experienced some failure in communication with medical providers (52.4%).5 Patients with limited local language proficiency are also likely to miss medical appointments and have difficulties arranging appointments due to the language barrier.9 Therefore, these patients have a poor level of satisfaction with their healthcare.14,18

To increase patient satisfaction with healthcare, it is necessary to provide interpreter services. Two studies pointed out that medical providers needed interpreter services for 43.2% of their patients, and 21–76% of medical providers stated they had poor access to these services.12,15 Moreover, 70.7% of limited English proficiency patients (LePPs) reported limited availability of interpreter services,13,14 and 26.4% reported that there were no interpreters in their healthcare institutions.5 LePPs also indirectly raise the cost of health services when they use interpreter services.12 LePPs who used interpreter services received more inpatient services and attended more office visits than those who did not.11 The authors of this study estimated that interpreter services for Medicaid recipients at about $4.7 million annually. Some healthcare organizations use online translation tools such as Google Translate and MediBabble to address the challenges of language barriers. These tools are free and easy to access, and they contribute to improving healthcare delivery, patient safety, and increased (up to 92%) the satisfaction of both medical professionals and patients.8

**DISCUSSION**

This review investigates the impact of language barriers on the delivery of healthcare and identifies possible solutions to the challenges posed by these language barriers. The first impact of language barriers is miscommunication between medical providers (physicians and nurses) and patients [Table 2]. This miscommunication contributes to a reduction in the satisfaction of both medical providers and patients, the quality of healthcare delivery, and patient safety. The second impact is an increase in indirect healthcare costs. The final impact is the application of online translation tools to healthcare organizations, which improves the quality of healthcare delivery and patient safety and increases the satisfaction of both medical professionals and patients.

Language barriers are a key cause of miscommunication between medical providers and patients, and negatively affect the quality of healthcare services and patient satisfaction. Hospital medical professionals perceive language barriers to be a source of workplace stress and an impediment to the delivery of high-quality healthcare.21 Much evidence shows a significant association between workplace stress and lower satisfaction among medical providers.22–24 In addition, studies indicate that language barriers contribute to medical professionals’ incomplete understanding of patients’ situations, delayed treatment or misdiagnoses, poor patient assessment and incomplete prescribed treatment.14,25

We also found that patients who do not speak the local language will have less satisfaction with their healthcare and less access to usual sources of healthcare. Even when patients with language barriers have access to healthcare, they have decreased satisfaction with that healthcare, decreased understanding of their diagnoses, and increased medication complications.25,26 A study conducted in Saudi Arabia showed that 25% of foreign patients reported that they had difficulty communicating with medical professionals and decreased satisfaction with their healthcare; 20% of medical professionals reported that health outcomes (i.e., healthcare errors, understanding patient needs, feeling satisfaction, and trust in nursing care needs) were always affected by language barriers.27 Interpreter services are necessary to solve the problem of language barriers in healthcare institutions and to increase the satisfaction of both medical professionals and patients.

To overcome language barriers, some healthcare institutions provide interpreter services; however, these services pose critical challenges in terms of access and financial burden. Previous studies have shown that most healthcare institutions have poor access to interpreter services or no services at all.12,14 The use of interpreter services contributes to increased patient satisfaction and improved
patient care among patients with language barriers.\textsuperscript{28} Interpreter services have a significant association with increased physician visits, prescription drugs by physicians, and receipt of preventative services among patients.\textsuperscript{29} However, providing interpreter services also increases the length and cost of physician visits.

MediBabble is an application created by medical students at the University of California, San Francisco, and released in 2011. Using advanced voice recognition software, it offers translations for thousands of medical instructions, as well as the questions for a standard medical history.\textsuperscript{30,31} The application contains thousands of instructions and translated questions, organized by symptom. Most questions can be answered with ‘yes’ or ‘no’ gestures.\textsuperscript{32} MediBabble can be used online or offline, and it allows physicians to take patient histories and make diagnoses when a language barrier exists.\textsuperscript{32} However, the application translates only six languages: English, Spanish, Russian, Cantonese, Haitian Creole, and Mandarin.\textsuperscript{32}

A case study showed that medical professionals and patients were highly satisfied with MediBabble; they reported that the application was fast and easy in terms of translating and collecting information.\textsuperscript{33} In a study done in Canada, MediBabble was used as one strategy to improve the delivery of healthcare for resettled Syrian refugees. It allowed medical professionals to take the refugees’ histories and also make diagnoses.\textsuperscript{30} In brief, MediBabble shows success as a medical translator. Using both interpreter services and online translation tools may offer more opportunities to improve healthcare delivery and patient safety.

This review has some limitations. First, there are few existing studies on the application of online translation tools in healthcare to address the problem of language barriers. Second, there are few studies evaluating the challenges of language barriers in private healthcare organizations. The impact of language barriers must be evaluated in both the public and the private sectors to address this problem.

This review also has several strengths. First, studies included in the review were conducted in both developing and developed countries. Second, the response rate was 100% in six of the studies. Third, the studies focused on various aspects of language barriers in healthcare, which helped the researchers to evaluate the challenges from multiple angles and determine solutions.

**CONCLUSION**

Language barriers can make the delivery of high-quality healthcare very challenging. They have a negative impact on the quality of healthcare, patient safety, and the satisfaction of medical professionals and patients. While some health organizations provide interpreter services to address these problems, these services indirectly increase the cost of health services and increase the length of treatment visits. Online translation tools such as Google Translate and MediBabble present possible solutions for overcoming these challenges. Further studies on the implications of language barriers and the effectiveness of online translation tools are recommended. Furthermore, new updates with more medical phrases for Google Translate and with more languages included for MediBabble application are recommended.

**Disclosure**
The authors declared no conflicts of interest.

**References**

1. Slade S, Sergent SR. Language barrier. In: StatPearls [Internet]; StatPearls Publishing; 2018.
2. Bischoff A, Denhaerynck K. What do language barriers cost? An exploratory study among asylum seekers in Switzerland. BMC Health Serv Res 2010 Aug;10(1):248.
3. Hilfinger Messias DK, McDowell L, Estrada RD. Language interpreting as social justice work: perspectives of formal and informal healthcare interpreters. ANS Adv Nurs Sci 2009 Apr-Jun;32(2):128-143.
4. Floyd A, Sakellariou D. Healthcare access for refugee women with limited literacy: layers of disadvantage. Int J Equity Health 2017 Nov;16(1):195.
5. Divi C, Koss RG, Schmaltz SP, Loeb JM. Language proficiency and adverse events in US hospitals: a pilot study. Int J Qual Health Care 2007 Apr;19(2):60-67.
6. Squires A. Evidence-based approaches to breaking down language barriers. Nursing2019 2017;47(9):34-40.
7. Cohen AL, Rivara F, Marcuse EK, McPhillips H, Davis R. Are language barriers associated with serious medical events in hospitalized pediatric patients? Pediatrics 2005 Sep;116(3):575-579.
8. Albrecht UV, Behrends M, Schneer R, Matthies HK, Von Jan U. Usage of Multilingual Mobile Translation Applications in Clinical Settings. 2013.
9. Ali PA, Watson R. Language barriers and their impact on provision of care to patients with limited English proficiency: Nurses’ perspectives. J Clin Nurs 2018 Mar;27(5-6):e1152-e1160.
10. Al-Khathami AM, Kojan SW, Aljumah MA, Alqahtani H, Alwail H. The effect of nurse-patient language barrier on patients’ satisfaction. Saudi Med J 2010 Dec;31(12):1355-1358.
11. Bagchi A, Stevens B. Estimates for the cost of interpretation services for Connecticut medicaid recipients. Mathematica Policy Research; 2006.
12. Bischoff A, Bovier PA, Rustremi I, Gariazzo F, Eyte A, Loutan L. Language barriers between nurses and asylum seekers: their impact on symptom reporting and referral. Soc Sci Med 2003 Aug;57(3):503-512.
13. de Moissac D, Bowen S. Impact of language barriers on quality of care and patient safety for official language francophones in Canada. 2018.
14. de Moissac D, Bowen S. Impact of language barriers on quality of care and patient safety for official language minority francophones in Canada. J Patient Exp 2019 Mar;6(1):24-32.
15. Kale E, Syed HR. Language barriers and the use of interpreters in the public health services. A questionnaire-based survey. Patient Educ Couns 2010 Nov;81(2):187-191.
16. Ngo-Metzger Q, Sorkin DH, Phillips RS, Greenfield S, Massagli MP, Clarridge B, et al. Providing high-quality care for limited English proficient patients: the importance of language concordance and interpreter use. J Gen Intern Med 2007 Nov;22(2)(Suppl 2):S24-330.
17. Pytel C, Fielden NM, Meyer KH, Albert N. Nurse-patient/visitor communication in the emergency department. J Emerg Nurs 2009 Sep;35(5):406-411.
18. Schlemmer A, Mash B. The effects of a language barrier in a South African district hospital. S Afr Med J 2006 Oct;96(10):1084-1087.
19. Van Rooyen D, Telford-Smith CD, Strümpfer J. Nursing in Saudi Arabia: reflections on the experiences of South African nurses. Health SA Gesondheid. 2010; 15(1).
20. Wilson E, Chen AH, Grumbach K, Wang F, Fernandez A. Effects of limited English proficiency and physician language on health care comprehension. J Gen Intern Med 2005 Sep;20(9):800-806.
21. Bernard A, Whitaker M, Ray M, Rockich A, Barton-Baxter M, Barnes SL, et al. Impact of language barrier on acute care medical professionals is dependent upon role. J Prof Nurs 2006 Nov-Dec;22(6):355-358.
22. Fiabane E, Giorgi I, Musian D, Squazzin C, Argentero P. Occupational stress and job satisfaction of healthcare staff in rehabilitation units. Med Lav 2012 Nov-Dec;103(6):482-492.
23. Salam A. Job stress and job satisfaction among health care professionals. Qatar Foundation Annual Research Conference Proceedings; 2016 HBKU Press Qatar p. HBOP2571.
24. Srivastava BDP, Singh MM. Job satisfaction among healthcare professional in public and private healthcare setup in India. 2018;6(1).
25. Karlimer LS, Kim SE, Melzner DO, Auerbach AD. Influence of language barriers on outcomes of hospital care for general medicine inpatients. J Hosp Med 2010 May-Jun;5(5):276-282.
26. Bowen S. The impact of language barriers on patient safety and quality of care. Société Santé en français. 2015.
27. Al-Harasis S. Impact of language barrier on quality of nursing care at armed forces hospitals, Taif, Saudi Arabia. Middle East Journal of Nursing 2013;7(4):17-24.
28. Squires A. Strategies for overcoming language barriers in healthcare. Nurs Manage 2018 Apr;49(4):20-27.
29. Brach C, Fraser I, Paez K. Crossing the language chasm. Health Aff (Millwood) 2005 Mar-Apr;24(2):424-434.
30. Rahman AA. Rising up to the challenge: strategies to improve health care delivery for resettled Syrian refugees in Canada. Univ Toronto Med J 2017;94(1):42.
31. Irfan ME, Ginige JA. Comparative study of medical reference and information mobile apps for healthcare professionals and students. Stud Health Technol Inform 2018;254:43-52.
32. Sheik-Ali S, Dowlut N, McConaghie G. Breaking down language barriers with technology. The Bulletin of the Royal College of Surgeons of England. 2016;98(3):138-140.
33. Boujon V, Bouillon P, Spechbach H, Gerlach J, Strazd L. Can speech-enabled phraseolists improve healthcare accessibility? A case study comparing Babeldr with MediBabble for anamnestic in emergency settings. 2018.