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Association between language discordance and unplanned hospital readmissions or emergency department revisits: a systematic review and meta-analysis

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ABSTRACT

Background and objective: Studies conflict about whether language discordance increases rates of hospital readmissions or emergency department (ED) revisits for adult and pediatric patients. The literature was systematically reviewed to investigate the association between language discordance and hospital readmission and ED revisit rates.

Data Sources: Searches were performed in PubMed, Embase, and Google Scholar on January 21, 2021, and updated on October 27, 2022. No date or language limits were used.

Study Selection: Articles that (1) were peer-reviewed publications; (2) contained data about patient or parental language skills; and (3) included either unplanned hospital readmission or ED revisit as one of the outcomes, were screened for inclusion. Articles were excluded if: unavailable in English; contained no primary data; or inaccessible in a full text form (e.g., abstract only).

Data Extraction and Synthesis: Two reviewers independently extracted data using PRISMA-ScR guidelines. We used the Newcastle-Ottawa Scale to assess data quality. Data were pooled using DerSimonian and Laird random-effects models. We performed a meta-analysis of 18 adult studies for 28-or 30-day hospital readmission; 7 adult studies of 30-day ED revisits; and 5 pediatric studies of 72-hour or 7-day ED revisits. We also conducted a stratified analysis by whether access to interpretation services was verified/provided for the adult readmission analysis.

Main Outcome(s) and Measure(s): Odds of hospital readmissions within a 28- or 30-day period and ED revisits within a 7-day period.

Results: We generated 4,830 citations from all data sources, of which 49 (12 pediatric; 39 adult) were included. In our meta-analysis, language discordant adult patients had increased odds of hospital readmissions (OR= 1.11, 95% CI 1.04-1.18). Among the 4 studies that verified interpretation services for language discordant patient-clinician interactions, there was no difference in readmission (OR=0.90, 95% CI 0.77-1.05); while studies that did not specify interpretation service access/use found higher odds of readmission (OR=1.14, 95% CI 1.06-1.22). Adult patients with a non-dominant language preference had higher odds of ED revisits (OR 1.07, 95% CI 1.004-1.152) compared to adults with a dominant language preference. In 5 pediatric studies, children of parents language discordant with providers had higher odds of ED revisits at 72-hours (OR=1.12, 95% CI 1.05-1.19) and 7-days (OR=1.02, 95% CI 1.01-1.03) compared to patients whose parents had language concordant communications.

Discussion: Adult patients with a non-dominant language preference have more hospital readmissions and ED revisits, and children with parents who have a non-dominant language preference have more ED revisits. Providing interpretation services may mitigate the impact of language discordance and reduce hospital readmissions among adult patients.

Study registration: The study and protocol were registered with PROSPERO (CRD42022302871).

KEY MESSAGES

What is already known about this topic: Prior studies have shown that language discordance impacts patient-clinician communication and patient ease of accessing care, but studies are conflicting about whether language discordance for patients or parents of pediatric patients increased hospital readmissions or unplanned ED revisits.

What this study adds: In a meta-analysis, we find that adult patients with non-dominant language preferences had higher odds of hospital readmissions and unplanned ED revisits compared to those without these language-related barriers, but adult patients provided with interpretation services do not have higher odds of hospital readmissions. Pediatric patients with parents with a non-dominant language preference also had higher odds of ED revisits at 72-hours and at 7-days in a meta-analysis.

How this study might affect research, practice, or policy: Given the increase in global migration, there are likely increasing more clinical situations when adult or pediatric patients that language-related communication barriers. These findings demonstrate the critical need to identify patients who may experience language-related communication barriers as well as the value of providing language access services to improve outcomes for language discordant populations.

INTRODUCTION

Global migration has skyrocketed, with over 272 million international migrants in 2019,[1] resulting in increasing linguistic diversity in many countries. This has brought about unprecedented levels of language-related barriers during clinical interactions.[2] In order to promote high-quality care, limit adverse events, and minimize disparities in access and outcomes, healthcare systems should provide culturally- and linguistically-tailored resources for language discordant interactions with patients and families.[3] Much of the prior literature has been based in English-speaking countries, and these populations have frequently been described as having limited English proficiency (LEP); in recognition of the global nature of this challenge, including in countries where English is not the dominant language, we will use the terms "language discordant/discordance" or "non-dominant language preference."

Patients and families who are language discordant with their clinical teams report lower patient satisfaction, worse health status, and lower rates of having a regular healthcare provider and obtaining preventive care services.[4–13] When patients and parents with a non-dominant language preference access care, they report difficulty communicating and understanding medical information from providers, comprehending written medical information, reading prescription bottles, and accessing interpretation services.[14–24] Individuals with non-dominant language preferences have also been shown to experience more medical errors and adverse health events.[25,26]

Adult and pediatric patients impacted by language-related barriers are particularly vulnerable during care transitions, including transitions from the hospital or emergency department (ED) to home. In one prospective study of patients discharged from the hospital, 20% of patients had adverse events within 2 weeks after discharge.[27] These adverse events are often

associated with readmissions and ED revisits, resulting in increased costs and worse patient experience and outcomes. Consequently, increasing efforts are focused on reducing readmissions.[28]Language discordance may contribute to avoidable hospital readmissions and ED revisits through a number of factors, including limited understanding about discharge or medication instructions or lower rates of outpatient follow-up leading to delays in care.[29–32]

Prior studies conflict about whether language discordance impacts rates of hospital readmission and ED revisits for either adult or pediatric patients.[23,33–37] However, many studies have been limited by samples size, evaluating a single site or specific conditions, or including only participants with non-dominant language preferences (without a comparison group). A recent systematic review exploring clinical outcomes (i.e., mortality, length of stay, readmissions/revisits, and complications) among hospitalized patients with LEP in English-speaking countries found evidence of higher readmission rates for chronic medical conditions (e.g., heart failure) but not for acute medical conditions or procedures; there were mixed findings on unplanned ED revisits.[33] However, this review did not include pediatric studies and did not conduct a meta-analysis. Another systematic review of health system-level interventions to improve language access for patients with LEP did not find any studies that measured readmission or ED revisit rates, and in general the studies included in that review focused primarily on process measures.[34] A review of interpretation service use in pediatric care settings was similarly inconclusive about clinical outcomes.[23]

Given the mixed findings in both the adult and pediatric literature about whether rates of unplanned ED revisits or readmissions are higher for language-discordant interactions and how interpreters impact these outcomes, we aimed to conduct a systematic review and meta-analysis to: (1) explore the association between language discordance (for spoken languages, not signed

languages) and unplanned hospital readmissions or ED revisits, and (2) assess the impact of interpretation services on disparities in these outcomes between patients with and without non-dominant language preference.

METHODS

Search strategy

Our systematic review methodology followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-ScR) guidelines[38,39] (Appendices 1 & 2). The study and protocol were registered with PROSPERO (CRD42022302871).

We developed a search strategy with a clinical librarian (JBW) using an iterative process that involved testing search terms, keywords, and controlled vocabulary, including MeSH and Emtree terms, and systematically examining the relevance of corresponding search results. Once testing of the search strategy was completed, we conducted a search for articles involving spoken language discordance and readmissions or ED revisits in PubMed, Embase, and Google Scholar on January 21, 2021; we updated this search on October 27, 2022. No date, language, or age limits were used. Detailed search strategies for each database can be found in Appendix 3. In total, we generated 4,380 references from all data sources.

Study selection

We included all articles that met the following inclusion criteria: (1) peer-reviewed publication; (2) reported data on patient or parent language skills/preference; and (3) included

either unplanned hospital readmission or ED revisit within any timeframe as one of the reported outcomes of the study.

We excluded articles that were qualitative studies, reviews, or case reports with less than 5 individuals. After contacting five authors to acquire the full text of articles, articles were also excluded that: were a conference abstract only or if we did not have full text of the article, did not contain primary data, or were not available in English (given the language skills of our team). We excluded articles that did not report readmission / ED revisit outcomes stratified by language or interpretation service use. We defined "interpretation service use" as explicit mention of access to or auditing of use of interpretation services by patients with a non-dominant language preference.

Two reviewers (EK & JC) screened 500 titles and abstracts concurrently; once consistency was ensured with a kappa of 0.73, the reviewers divided the remaining studies and screened titles and abstracts separately. For full text screening, four reviewers (EK, JC, MS, & JW) independently double-screened the full text of each article. Disagreements about whether studies should be included and differences during data extraction were resolved by consensus among reviewers during team meetings.

Data extraction

A standardized form was created to extract data from each study using the Covidence systematic review management software (Veritas Health Innovation; Melbourne, Australia)[40] in the following areas: 1) study setting, 2) study type and methodology, 3) characteristics of the participants, 4) characteristics of the intervention, if applicable (e.g. intervention type and duration), and 5) outcome measures and results. Four reviewers (EK, JC, MS, and JW)

independently double-extracted data from each article and collaboratively reviewed extracted data regularly to ensure agreement.

Assessment of risk of bias and quality

The Newcastle-Ottawa Scale (NOS) was used for quality assessment in three dimensions (patient selection, comparability, and outcome) to determine overall quality.[41,42] The NOS is a validated tool to assess risk of bias and quality for cohort studies by evaluating cohort selection, cohort compatibility, and assessment of outcomes. We modified the NOS for non-cohort studies, similar to the adaptation by Modesti et al.[43] The NOS score ranges from 0 and 9, with a higher score indicating higher-quality studies. A score of 7 or more points (≥3 points in the selection domain, ≥2 points in the comparability domain, and ≥2 points in the outcome domain) is accepted as good quality rating.[44] Four reviewers (EK, JC, MS, and JW) independently double- extracted data on study quality and resolved disagreements by consensus.

Data analysis

We conducted meta-analyses of adult patient studies on two outcomes: (a) 28 or 30-day hospital readmission and (b) 30-day ED revisits. Both analyses evaluated differences in outcomes based on whether patients had a dominant language preference or not. Given the importance of interpretation services at mitigating challenges in language discordant patient-clinician relationships, we also conducted two subgroup analyses of the readmission outcome: (a) among only studies that provided interpretation service access or verified interpretation service usage among patients with a non-dominant language preference and (b) among studies in which interpretation service access or use was not specified.

We conducted meta-analyses of pediatric studies on: (a) 72-hour ED revisit and (b) 7-day ED revisits. Both analyses evaluated differences in outcomes based on whether children's parents had a non-dominant language preference or not. We did not conduct meta-analyses for hospital readmission among pediatric studies since fewer than three studies had the same outcome and heterogeneity was relatively high.[45]

Studies that included regression results for separate patient groups were included multiple times (referred to as "references" in the results).[46] For example, a study that separately reported results for patients admitted with COPD vs patients admitted with CHF[47] had the respective regression estimates included separately in the meta-analysis, and each of those separate estimates are different "references." Patient groups were included as separate references when they were independent groups of patients in the same study, without any overlap with other patients groups; that is, data from these patients were gathered separately and not correlated (e.g., Chinese-speakers only vs Spanish-speakers only). DerSimonian and Laird random-effects models were used to perform the meta-analyses. Heterogeneity was assessed using the I^2 statistic, and risk of bias was evaluated with both Begg and Egger's tests and a funnel plot, which found no publication bias ($p>0.35$). We performed a sensitivity analysis to identify outlier studies by using a jackknife method[48] where we left out one study at a time and recalculated the overall meta-analysis to ensure that eliminating a study did not change the summary statistic. Using this approach, no outlier studies were found, and all studies were included in the meta-analysis. All analyses were done using Stata 16.0 (College Station, TX).

RESULTS

The literature search yielded 4,380 articles. After excluding duplicates, 3,000 articles were screened for inclusion based on title and abstract, with 1,941 eliminated after title/abstract screening, 8 excluded as we were unable to find full text, and 1,002 excluded based on exclusion criteria after full text review. Forty-nine studies were included, as indicated in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Chart (Figure 1).

Characteristics and participant traits in included studies

Table 1 reports characteristics of the 49 studies. (See Appendix 4 for more details). Thirty-six were conducted in the United States,[36,37,49–82] eight in Australia,[83–90] four in Canada,[47,91–93] and one in Switzerland.[94] Except for three studies that used both English and French as the dominant language, all studies focused exclusively on patients with limited English proficiency.[91,92,94] The majority were observational studies; 5 studies were non-randomized experimental studies.[50,51,62,82,93] Thirty-six studies evaluated adult patients,[47,51–56,59–63,65–69,71–81,83–86,88,89,92,94] 12 focused on pediatric patients,[36,37,49,50,57,58,64,70,82,90,91,93] and one included both adults and pediatric patients.[87]

Table 1a. Study characteristics of studies with adult patients who are language discordant with their clinical teams compared to those who are not

Year	Author	Location	Study Design	Patient population	Outcome	Quality NOS
Hospital readmission						
2010	Karliner	San Francisco, USA	Retrospective cohort study	Adult medicine inpatients	30-day readmission	8
2012	Bhalla	Bronx, USA	Retrospective cohort study	Adult inpatients	30-day readmission	7
2014	Black	USA	Retrospective cohort study	Adult medicine inpatients	30-day readmission	7
2014	Regalbuto	New York, USA	Retrospective cohort study	Adult inpatients admitted for decompensated heart failure	30-day readmission	6
2015	Wasfy	Boston, USA	Case-control study	Adult inpatients admitted for PCI	30-day readmission	8
2016	Wilbur	Baltimore USA	Retrospective cohort study	Adult surgical gynecologic oncology inpatients	30-day readmission	7
2017	Karliner	San Francisco, USA	Non-randomized experimental study	Adult medicine inpatients	30-day readmission	8
2019	Chan	San Francisco, USA	Retrospective cohort study derived from RCT	Adult medicine inpatients	30-day readmission	8
2020	Beagley	Melbourne, Australia	Retrospective cohort study	Adult inpatients	30-day readmission	7
2020	Biswas	Victoria, Australia	Retrospective cohort study	Adult patients who had PCI for STEMI	30-day readmission	5
2020	Fazzalari	Central Massachusetts, USA	Retrospective cohort study	Adult inpatients with cholecystitis	30-day readmission	7
2021	Rambachan	San Francisco, USA	Retrospective cohort study	Adult medicine inpatients	7-day readmission	8
2021	Schaefer	Boston, USA	Retrospective cohort study	Adult women who had nulliparous, term, singleton, vertex deliveries	30-day maternal readmission	7
2022	Abedini	Seattle, USA	Retrospective cohort study	Community-based adults (65+) who died between 2010-2018	30-day readmission (within last 90- and last 180-days of life)	9
2022	Manuel (craniotomy)	San Francisco, CA USA	Retrospective cohort study	Adult inpatients undergoing craniotomy	30-day readmission	6
2022	Manuel (arthroplasty)	San Francisco, USA	Retrospective cohort study	Adult inpatients undergoing total joint arthroplasty	30-day readmission	6
2022	Maurer	Boston, USA	Retrospective cohort study	Adult inpatients on trauma service	30-day readmission	9
2022	Miteva	Zurich, Switzerland	Case-control study	Adult inpatients in psychiatric hospital	1-year readmission	8
2022	Squires	New York, USA	Retrospective cohort study	Adults receiving care from home health agency	30-day readmission	9
Hospital readmission and unplanned ED revisit						
2015	Lopez	Boston, USA	Retrospective cohort study	Adult medicine inpatients	30-day readmission and 30-day ED revisit	8
2016	Narula	Boston, USA	Retrospective cohort study	Adults undergoing colectomy	30-day readmission and 30-day ED revisit	5
2017	Inagaki	Boston, USA	Retrospective cohort study	Adults undergoing nonemergent infrainguinal bypass	30-day readmission and 30-day ED revisit	7
2019	Rawal	Ontario, Canada	Retrospective cohort study	Adult inpatients	30- and 90-day day readmission and 30-day ED revisit	9
2020	Seman	Melbourne, Australia	Retrospective cohort study	Adults admitted for heart failure	30-, 180-, and 365- day readmission and 30-, 180-, and 365-day ED revisit	7
2022	Seale	Ontario, Canada	Retrospective cohort study	Adults receiving publicly-funded long-term home care services	30-day readmission and 30-day ED revisit	9

2022	Stolarski	Boston, USA	Retrospective cohort study	Adult inpatients undergoing bariatric surgery	30- day and 1-yr readmission; 30-day and 1-year ED revisits	6
Unplanned ED revisit						
2016	Ngai	New York City, USA	Retrospective cohort study	Adult patients seen in ED	72-hour ED revisit	8
2018	Schulson	Boston, USA	Retrospective cohort study	Adult patients seen in ED	72-hour ED revisit	7
2020	Feeney	Boston, USA	Retrospective cohort study	Adult surgical oncology inpatients	30-day ED revisit	8
2021	Hutchinson* *includes pediatrics	Sydney, Australia	Retrospective cohort study	Patients of all ages seen in ED	28-day ED revisit	7
2021	Wong	Boston, USA	Retrospective cohort study	Adult inpatients undergoing colorectal surgery	30-day ED revisit	6
2022	James	Gainesville, USA	Retrospective cohort study	Adult patients seen in ED	9-day ED revisit	6

Table 1b. Study characteristics of studies with pediatric patients with parents who are language discordant with their child's clinical teams compared to those who do not

Year	Author	Location	Study Design	Patient population	Outcome	Quality NOS
Hospital readmission						
2006	Young	Ontario, Canada	Non-randomized experimental study	Pediatric outpatients receiving tele-homecare	8 week- readmission	3
2016	Eneriz-Wiemer	Palo Alto, USA	Retrospective cohort	Pediatric outpatients and inpatients with preterm birth or very low birth weight	30-day readmission	6
2017	Ju	Palo Alto, USA	Retrospective cohort	Pediatric inpatients	7- and 30-day readmission	9
2021	Yeh	Los Angeles, USA	Cross-sectional study	Pediatric patients admitted to NICU	12 month- readmission	3
2021	Zhou	Western Australia	Retrospective cohort study	Pediatric inpatients	30-day readmission	8
Unplanned ED revisit						
2013	Gallagher	Boston, USA	Retrospective cohort	Pediatric patients seen in ED	72-hour ED revisit	8
2016	Saunders	Ontario, Canada	Retrospective cohort	Pediatric patients seen in ED	7-day ED revisit	8
2017	Samuels-Kalow	Boston, USA	Prospective cohort	Pediatric patients seen in ED	72-hour ED revisit	7
2019	Greenky	Atlanta, USA	Retrospective cohort	Pediatric patients seen in ED	7-day ED revisit	9
2020	Poel	Aurora, USA	Non-randomized experimental study	Pediatric outpatient	30-day ED revisit	6
2021	Martinez	Virginia, USA	Non-randomized experimental study	Pediatric patients seen in ED	48-hour ED revisit	6
2021	Portillo	Boston, USA	Retrospective cohort study	Pediatric patients seen in ED	72-hour ED revisit	8

Table 1c. Study characteristics of studies with only patients who are language discordant with their clinical teams

Year	Author	Location	Study Design	Patient population	Intervention description	Outcome	Quality NOS
Hospital readmission							
2012	Lindholm	Worcester, USA	Retrospective cohort	Adult inpatients	Interpreter provision	30-day readmission	8
2019	Abbato	Brisbane, Australia	Retrospective cohort study	Adult inpatients	Interpreter provision	30-day readmission	7
2019	Blay	Sydney, Australia	Retrospective cohort study	Adult inpatients	Interpreter provision	28-day readmission	5
2022	Shiner	Sydney, Australia	Retrospective cohort study	Adult inpatients for subacute rehabilitation	Interpreter provision	6-month readmission	5
Hospital readmission and unplanned ED revisit							
2017	Aguayo-Rico	New Mexico, USA	Non-randomized experimental study	Adult inpatients	Updated discharge instruction template for Spanish speakers	30-day readmission and 30-day ED revisit	3

Abbreviations: DHH=deaf/hard of hearing; ED=emergency department; PCI= percutaneous coronary intervention; RCT=randomized controlled trial; STEMI= ST elevation myocardial infarction; NICU=neonatal intensive care unit; USA=United States of America

Although most studies included hospitalized patients from the general medicine service, 17 of the adult studies focused on specific chief complaints or procedures (i.e., patients with cholecystitis or who received percutaneous coronary intervention).[55,56,60,63,68,69,71,73,75–77,79,80,85,88,89,94] Other studies focused on community-dwelling adults receiving home health care,[78] adults receiving long-term care,[92] or a cohort of older community-based adults.[74]

The studies that evaluated readmission among pediatric patients included: three studies of patients who received care in the hospital,[37,70,90] one of outpatients receiving tele-home care,[93] and one of children with preterm birth or very low birth weight.[49]

Studies defined language discordance in many ways. Approaches included the patient's or parent's (if pediatric population) self-report of primary language or language preference (41 studies); billing event or need for interpretation services noted in the electronic health record (14 studies); or an assessment of language proficiency using a standardized questionnaire (2 studies).

Twenty-eight studies included hospital readmission as the outcome of interest, 13 had emergency department revisit,[36,37,49,50,52–59,61–66,68–70,72–78,80–87,89–91,93,94] and 8 had both readmission and emergency department revisit.[47,51,60,67,71,79,88,92] The time-frame of hospital readmissions ranged from 7- to 365 days, while ED revisits ranged from 72-hours to 365 days.

Quality of included studies

Tables 1a-1c shows the NOS quality assessment of the 49 studies. A majority (33 studies) had a score of 7 or higher.[36,37,47,52–62,64–69,72–74,77,78,83,84,87,88,90–92,94] Studies with the lowest scores had issues related to selection (representativeness of the cohort, sample size), comparability (controlling for potential confounding factors), and outcome (assessment of

outcome). (See Appendix 5 for more details.)

Hospital readmissions

Adult patients

Of the 31 adult studies that evaluated hospital readmissions, 11 (Appendix 4, Table 1a) found a statistically significant association between language discordance and hospital readmission. In our meta-analysis (Figure 2) of 30 references from 18 adult studies, we found increased odds of 28- or 30-day hospital readmissions among those with a non-dominant language preference [odds ratio (OR) = 1.11, 95% confidence interval (CI) 1.04-1.18] compared to those with a dominant language preference.

Adult patients: stratified by interpretation service use

In the analysis that separately evaluated studies where it was known that interpretation services were provided for patients with non-dominant language preference vs studies where it was unknown whether interpretation services were provided, we found among the four references from two studies that provided interpretation service access or verified interpretation service usage, there was no statistically significant difference in hospital readmission (OR=0.90, 95% CI 0.77 -1.05, figure 2 bottom half) compared to those with a dominant language preference. In contrast, among 26 references from 17 studies in which interpretation service access or use was not specified, adults with non-dominant language preference had higher odds of hospital readmission (OR=1.14, 95% CI 1.06-1.22, figure 2 top half) compared to those with a dominant language preference.

Pediatric patients

In the pediatric population, 3 studies conducted multivariable analyses examining the association between parental non-dominant language preference and hospital readmissions (Figure 3). None of the studies had statistically significant results.

Emergency department revisits

Adult patients

Among studies that evaluated ED revisits among adults with non-dominant language preference, less than half (6 of 13) found a statistically significant difference between patients with versus without a dominant language preference. Our meta-analysis (Figure 4) of 14 references from 7 adult studies of 30- day ED revisits found that patients with a non-dominant language preference had higher odds of unplanned ED revisits (OR=1.07, 95% CI 1.00-1.15).

Pediatric patients

Of 5 pediatric studies that evaluated ED revisits, 2 found a statistically significant difference among pediatric patients with parental non-dominant language preference compared to those without. In our meta-analysis, we found a statistically significant difference in odds of ED revisits within 72 hours (OR=1.12, 95% CI 1.05-1.19) and within 7-days (OR=1.02, 95% CI 1.01-1.03) among pediatric patients whose parents did or did not have a dominant language preference (Figure 5).

DISCUSSION

In this review that explored the role of language discordance on hospital readmissions and unplanned ED revisits, although results from individual studies were mixed, our meta-

analysis demonstrated higher odds of 28- or 30-day hospital readmission among adults with a non-dominant language preference. Moreover, studies that increased access to or validated use of interpretation services for language discordant adult patients found no difference in hospital readmission while those that did not specify interpretation service access/use for language discordant patients had higher odds of readmission for patients with non-dominant language preference. We also found higher odds of unplanned ED revisit within 30 days for adults with non-dominant language preference and higher odds of ED revisit at 72-hours and 7 days for pediatric patients with parents who had a non-dominant language preference.

Our findings demonstrate that language discordance for adult patients and parents of pediatric patients is associated with greater odds of readmission and/or ED revisit, which is consistent with a prior review that found higher rates of readmission for adults admitted for chronic medical conditions.[33] We expand on prior reviews[23,33,34] by quantitatively demonstrating that: (a) both adult and pediatric unplanned ED revisit rate is also higher when language discordance exists and (b) access to interpretation services may mitigate the impact of language discordance on disparities in adult readmission rates.

One key finding from this study and other reviews[23,33,34] is that literature on the impact of language discordance on clinical or utilization outcomes is still quite limited, much less the impact of language access interventions on these outcomes. Few studies of interventions to address language discordance, such as providing professional interpretation services, have focused on clinical or utilization outcomes.[34] In our study there was no difference in odds of hospital readmission in studies that provided interpretation service access or verified interpretation service use, suggesting that interpretation services may play an important role in reducing readmissions in this underserved population. This expands on prior studies that have

also shown that professional interpretation services decrease communication errors, improve quality of care, and increase patient satisfaction.[34,95] Professional interpretation services may mitigate disparities in care and clinical outcomes when patient-clinician language discordance exists, highlighting the importance of investing in language access resources. However, future research is needed to better understand how language discordance and interventions such as professional interpretation services impact clinical outcomes and quality of care. Since many of these studies are single site studies, it is crucial for studies to have similar outcomes so that meta-analyses can be more easily conducted.

The inadequate evaluation of the impact of language discordance on utilization and clinical outcomes is particularly dire in the pediatric setting. There were not only a limited number of studies evaluating hospital readmission in the pediatric population, but also the studies were heterogeneous in terms of the time frame, prohibiting synthesis in a meta-analysis. The weak evidence base for pediatric patients further impedes our ability to establish causal relationships between language discordance and hospital readmissions. In addition, pediatric patients are less liked to be readmitted, which may limit the ability to detect differences between groups.[96,97] More studies need to be done to understand the impact of parental language discordance on hospital readmissions or other more pediatric-relevant utilization outcomes.

Future studies should also pay deliberate intention to how language discordance is defined. The studies included in this review varied in their approach to identifying language barriers, ranging from self-report on a survey to language preference denoted in the electronic health record (EHR) to a billing code for interpretation service. Self-report of language preference and need for interpretation services has been recommended by many organizations as the “gold standard.”[98–100] However, reporting of language preference is complex; for

example, patients may report a dominant language preference because they are concerned about being discriminated against or receiving substandard care.[101,102] In addition, individuals who speak multiple languages may prefer different languages for different activities. Electronic health records, particularly in settings with high rates of EHR adoption, have the potential to be an effective approach to collecting data on language preference and needs. However, lack of interoperability and challenges with sharing information across different healthcare providers limit the impact of this approach.[103] Moreover, the reliability and quality of the language data collected are suboptimal and can vary significantly.[104–107] This is particularly the case for pediatric patients, when it is unknown if the language preference reflects an adolescent versus parent's language preference.[108] This highlights the lack of standardization of collecting data on adult and pediatric patients' language needs and a need for both health systems and researchers to implement a more uniform approach to identifying patients who experience language discordance-related barriers to healthcare and whose specific language preferences (e.g., a patient vs a parent) is most impactful on clinical outcomes.

One key challenge to interpreting and analyzing studies on how language barriers impacts clinical care is the complex relationship between language, race/ethnicity, migration status, and socioeconomic status.[109–111] Through classism, racism, and xenophobia, these intersectional identities also impact quality of care, patient-reported outcomes, and clinical outcomes.[110,112,113] Moreover, despite global migration to many non-English speaking countries and the consequent language barriers that exist in healthcare,[114–117] we have limited insights on how language discordance impacts care worldwide or more broadly how the dynamics of cultural, race/ethnicity, and language differ in other countries[118]. Studies on the impact of language discordance on health equity need to better understand the exact mechanisms

on how language discordance impacts care and how this intersects with other characteristics, such as race/ethnicity, migration status, country of origin, or socioeconomic status, that also may impact care through the same mechanisms.[113]

This review was limited in several ways. The studies in our review were conducted in the United States, Australia, Canada, and Switzerland and our findings may not be generalizable to other countries. In addition, we relied primarily on single-reviewer screening of title and abstract, though we double-screened until we achieved an appropriate inter-rater reliability. While we included one study that had patients that were deaf/hard of hearing (DHH), we did not explicitly include DHH in our search term for patients with non-dominant language preference; therefore, our study did not include a comprehensive review of studies of patients that were DHH. Given the limited evidence in the pediatric literature, we have much less understanding of the causal relationships between language discordance and our studied outcomes. Furthermore, given the language skills of our team, most studies included in this review were conducted in English-speaking countries; we excluded studies that were not available in English, and it is possible that we missed studies published in non-English language journals. We were also limited by our inability to acquire full text for several articles; though we did attempt to contact authors, we did not receive a response from all the authors. Finally, the studies included were somewhat heterogeneous (due to differences in study design, ascertainment of language discordance, sample size, study participant inclusion criteria, assessment/provision of language access, timing of outcome assessment). This limits our ability to precisely quantify the association between language barriers and the studied outcomes.

In conclusion, adult patients with non-dominant language preference experience higher hospital readmission and ED revisit rates compared to those without non-dominant language

preference, while pediatric patients with parental non-dominant language preference are more likely to have unplanned ED revisits. Providing high-quality interpretation services may mitigate some of these disparities. Given the increase in global migration and prevalence of language discordance, it is imperative that healthcare systems and researchers improve efforts to identify when language discordance exists and mitigate the impact of language discordance related barriers on health equity.

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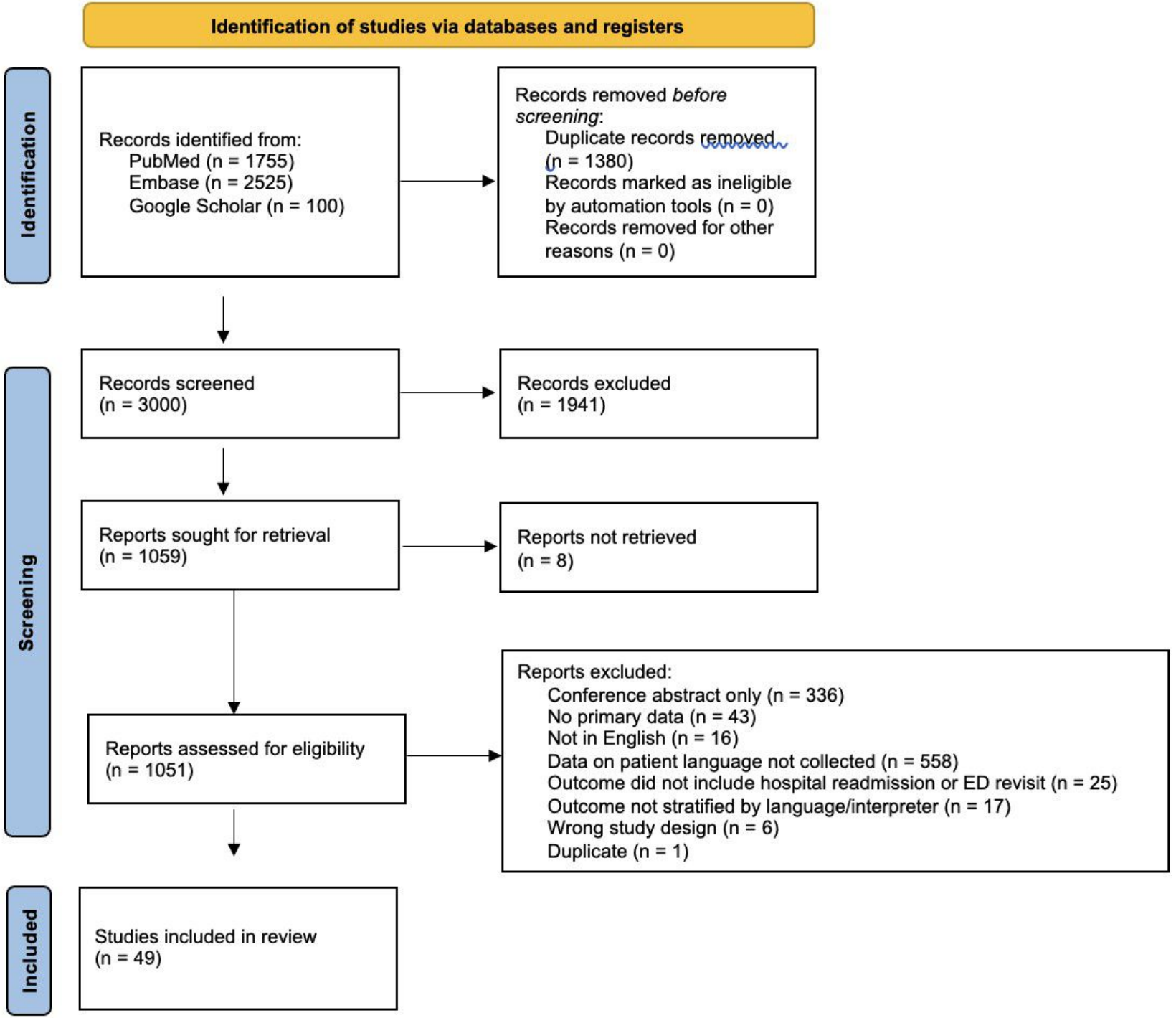

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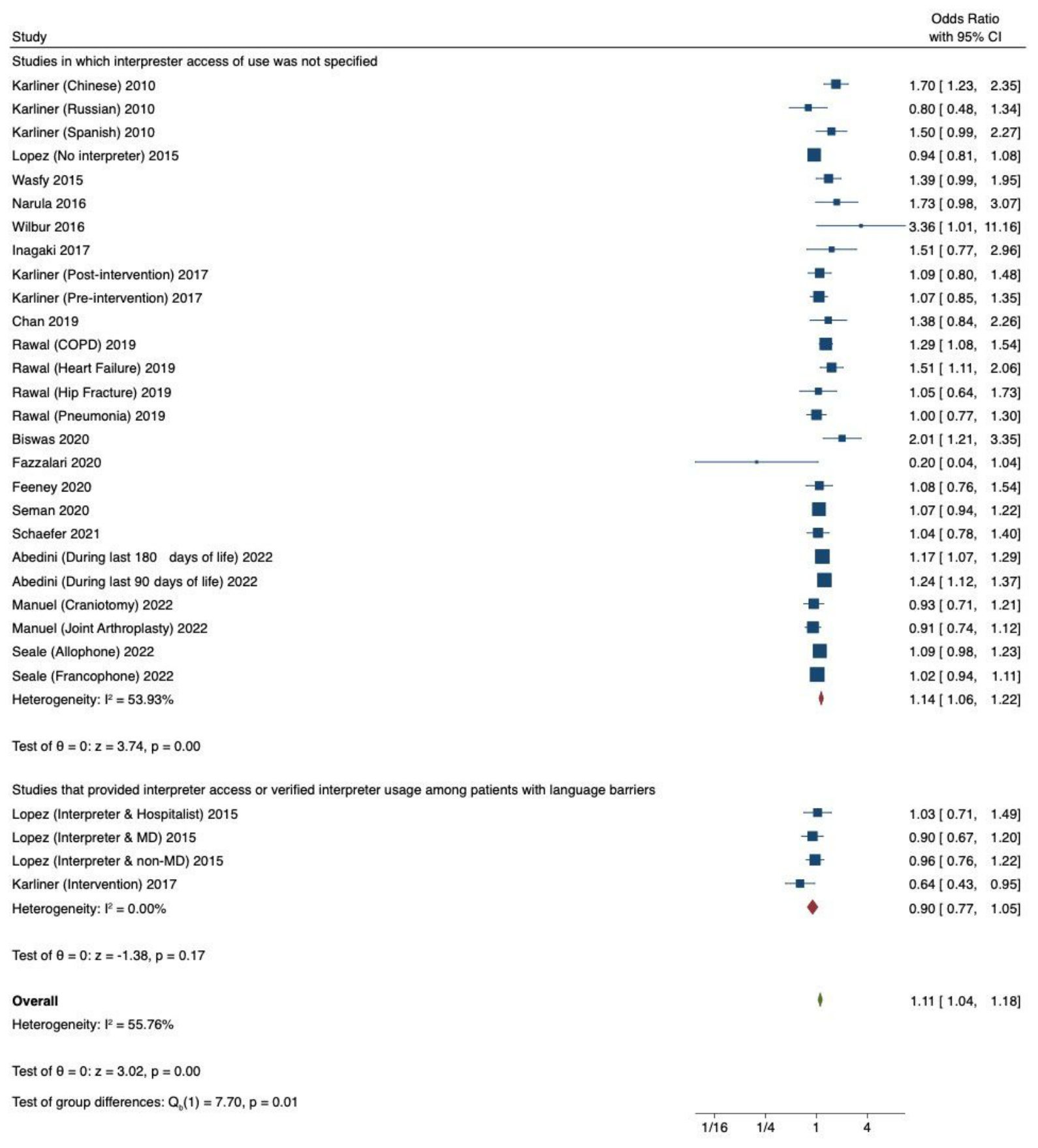
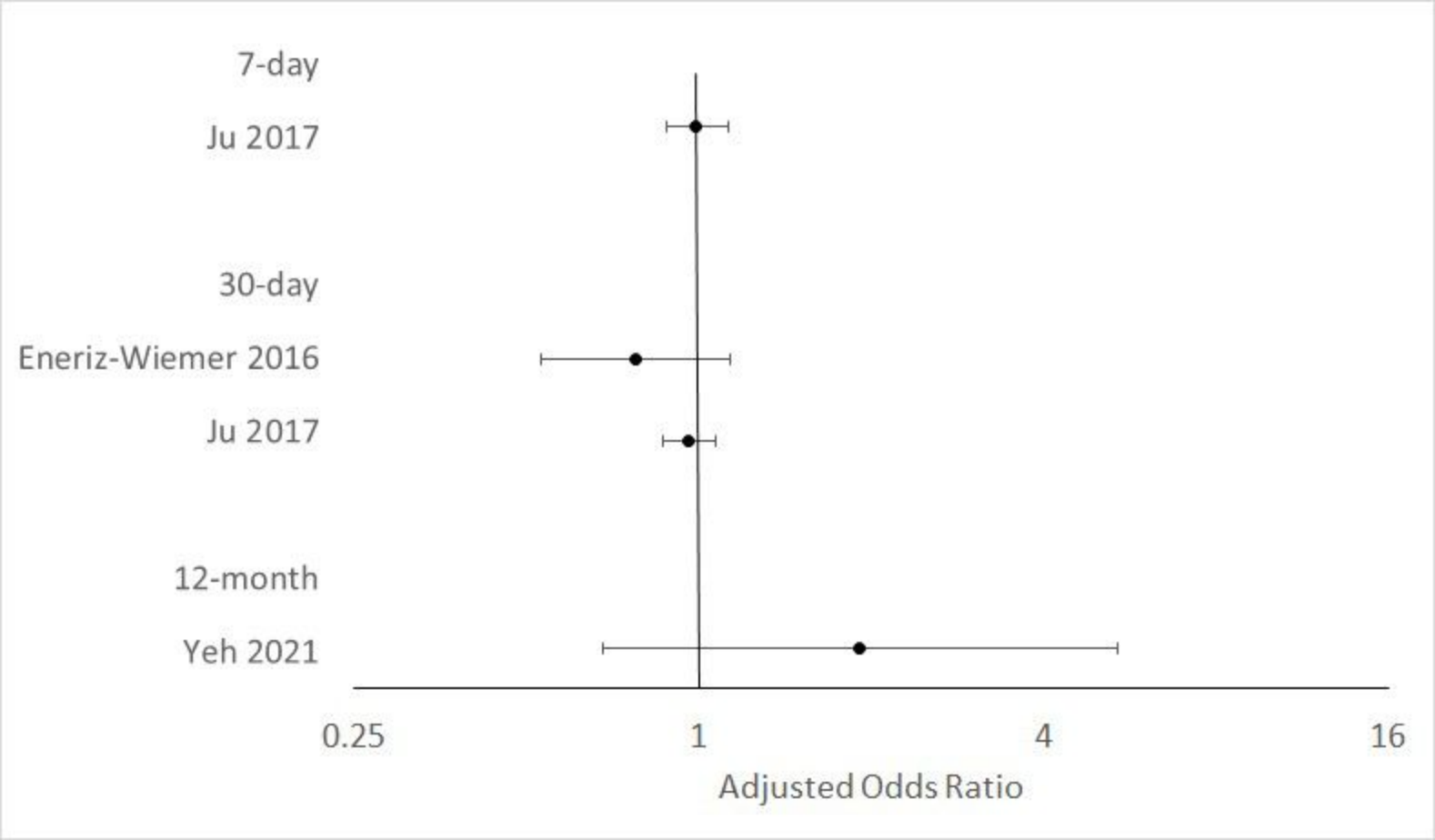
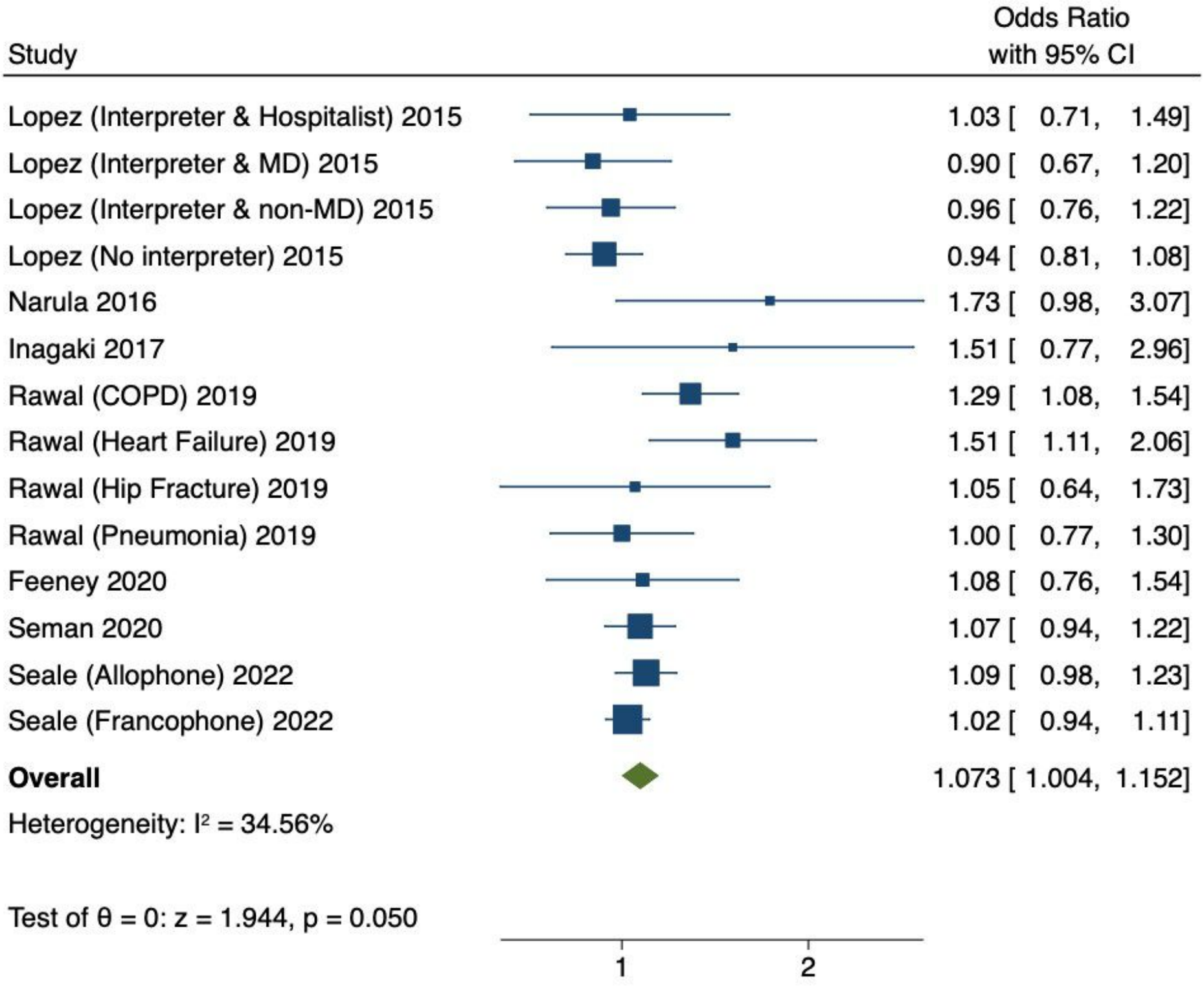
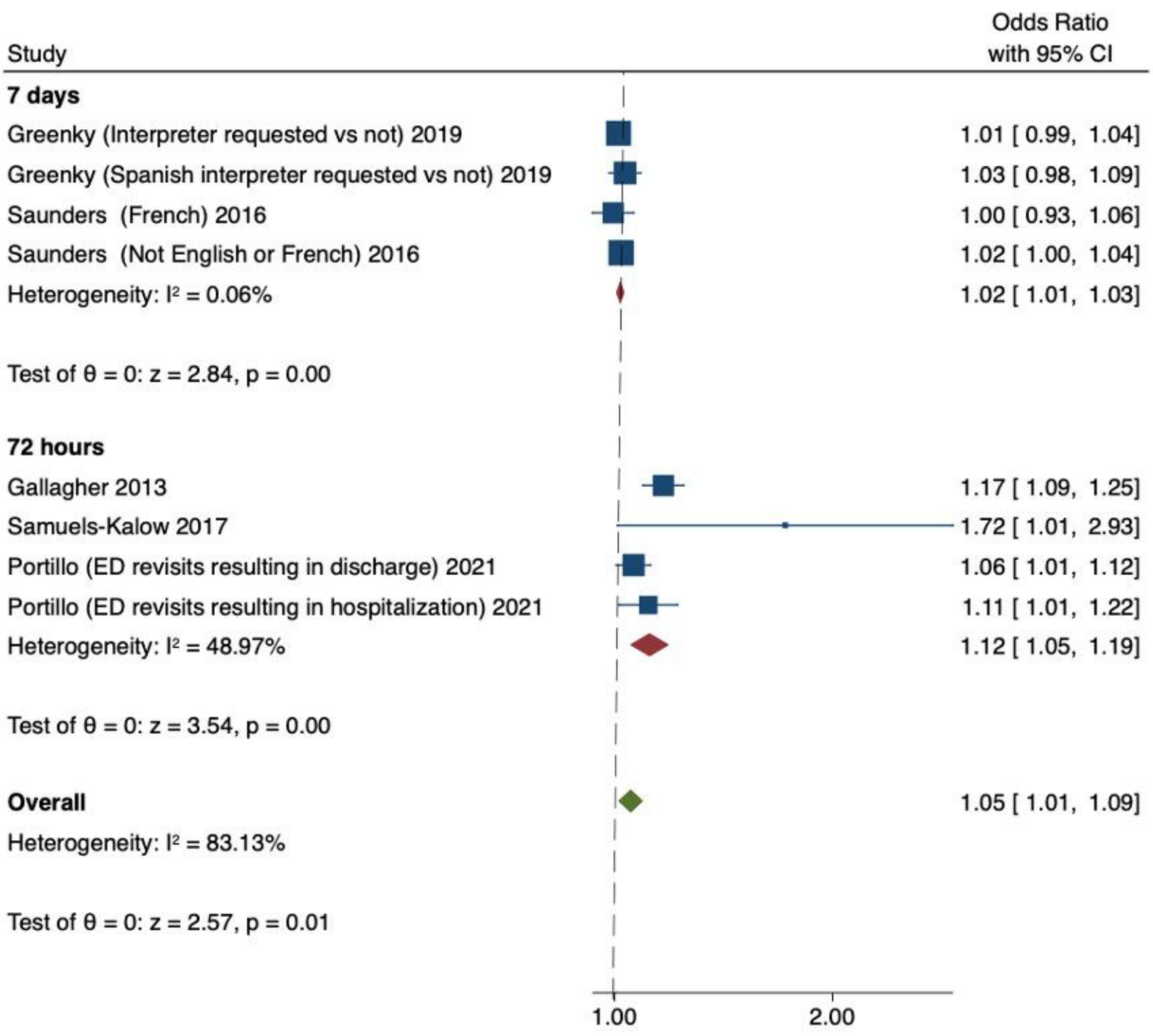

Study
Odds Ratio with 95% CI
Studies in which interprester access of use was not specified
Karliner (Chinese) 2010 1.70 [1.23, 2.35]
Karliner (Russian) 2010 0.80 [0.48, 1.34]
Karliner (Spanish) 2010 1.50 [0.99, 2.27]
Lopez (No interpreter) 2015 0.94 [0.81, 1.08]
Wasfy 2015 1.39 [0.99, 1.95]
Narula 2016 1.73 [0.98, 3.07]
Wilbur 2016 3.36 [1.01, 11.16]
Inagaki 2017 1.51 [0.77, 2.96]
Karliner (Post-intervention) 2017 1.09 [0.80, 1.48]
Karliner (Pre-intervention) 2017 1.07 [0.85, 1.35]
Chan 2019 1.38 [0.84, 2.26]
Rawal (COPD) 2019 1.29 [1.08, 1.54]
Rawal (Heart Failure) 2019 1.51 [1.11, 2.06]
Rawal (Hip Fracture) 2019 1.05 [0.64, 1.73]
Rawal (Pneumonia) 2019 1.00 [0.77, 1.30]
Biswas 2020 2.01 [1.21, 3.35]
Fazzalari 2020 0.20 [0.04, 1.04]
Feeney 2020 1.08 [0.76, 1.54]
Seman 2020 1.07 [0.94, 1.22]
Schaefer 2021 1.04 [0.78, 1.40]
Abedini (During last 180 days of life) 2022 1.17 [1.07, 1.29]
Abedini (During last 90 days of life) 2022 1.24 [1.12, 1.37]
Manuel (Craniotomy) 2022 0.93 [0.71, 1.21]
Manuel (Joint Arthroplasty) 2022 0.91 [0.74, 1.12]
Seale (Allophone) 2022 1.09 [0.98, 1.23]
Seale (Francophone) 2022 1.02 [0.94, 1.11]
Heterogeneity: I^2 = 53.93% 1.14 [1.06, 1.22]
Test of θ = 0: z = 3.74, p = 0.00
Studies that provided interpreter access or verified interpreter usage among patients with language barriers
Lopez (Interpreter & Hospitalist) 2015 1.03 [0.71, 1.49]
Lopez (Interpreter & MD) 2015 0.90 [0.67, 1.20]
Lopez (Interpreter & non-MD) 2015 0.96 [0.76, 1.22]
Karliner (Intervention) 2017 0.64 [0.43, 0.95]
Heterogeneity: I^2 = 0.00% 0.90 [0.77, 1.05]
Test of θ = 0: z = -1.38, p = 0.17
Overall 1.11 [1.04, 1.18]
Heterogeneity: I^2 = 55.76%
Test of θ = 0: z = 3.02, p = 0.00
Test of group differences: $Q_b(1)$ = 7.70, p = 0.01
1/16
1/4
1
4


7-day
Ju 2017
30-day
Eneriz-Wiemer 2016
Ju 2017
12-month
Yeh 2021
0.25
1
4
16
Adjusted Odds Ratio


Study
Odds Ratio with 95% CI
Lopez (Interpreter & Hospitalist) 2015
1.03 [0.71, 1.49]
Lopez (Interpreter & MD) 2015
0.90 [0.67, 1.20]
Lopez (Interpreter & non-MD) 2015
0.96 [0.76, 1.22]
Lopez (No interpreter) 2015
0.94 [0.81, 1.08]
Narula 2016
1.73 [0.98, 3.07]
Inagaki 2017
1.51 [0.77, 2.96]
Rawal (COPD) 2019
1.29 [1.08, 1.54]
Rawal (Heart Failure) 2019
1.51 [1.11, 2.06]
Rawal (Hip Fracture) 2019
1.05 [0.64, 1.73]
Rawal (Pneumonia) 2019
1.00 [0.77, 1.30]
Feeney 2020
1.08 [0.76, 1.54]
Seman 2020
1.07 [0.94, 1.22]
Seale (Allophone) 2022
1.09 [0.98, 1.23]
Seale (Francophone) 2022
1.02 [0.94, 1.11]
Overall
1.073 [1.004, 1.152]
Heterogeneity: I² = 34.56%
Test of θ = 0: z = 1.944, p = 0.050
1
2


Study
Odds Ratio with 95% CI
7 days
Greenky (Interpreter requested vs not) 2019
1.01 [0.99, 1.04]
Greenky (Spanish interpreter requested vs not) 2019
1.03 [0.98, 1.09]
Saunders (French) 2016
1.00 [0.93, 1.06]
Saunders (Not English or French) 2016
1.02 [1.00, 1.04]
Heterogeneity: I² = 0.06%
1.02 [1.01, 1.03]
Test of θ = 0: z = 2.84, p = 0.00
72 hours
Gallagher 2013
1.17 [1.09, 1.25]
Samuels-Kalow 2017
1.72 [1.01, 2.93]
Portillo (ED revisits resulting in discharge) 2021
1.06 [1.01, 1.12]
Portillo (ED revisits resulting in hospitalization) 2021
1.11 [1.01, 1.22]
Heterogeneity: I² = 48.97%
1.12 [1.05, 1.19]
Test of θ = 0: z = 3.54, p = 0.00
Overall
1.05 [1.01, 1.09]
Heterogeneity: I² = 83.13%
Test of θ = 0: z = 2.57, p = 0.01
1.00
2.00

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	4-5
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	5
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	6
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	6, Appendix 3
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix 3
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	6-7
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Fig 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	n/a
Study characteristics	17	Cite each included study and present its characteristics.	Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Table 1
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	11-13
	23b	Discuss any limitations of the evidence included in the review.	13-14
	23c	Discuss any limitations of the review processes used.	14
	23d	Discuss implications of the results for practice, policy, and future research.	11-15
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	6
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	6
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	n/a
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

PRISMA-S Checklist

Section/topic	#	Checklist item	Location(s) Reported
INFORMATION SOURCES AND METHODS			
Database name	1	Name each individual database searched, stating the platform for each.	Appendix 3
Multi-database searching	2	If databases were searched simultaneously on a single platform, state the name of the platform, listing all of the databases searched.	n/a
Study registries	3	List any study registries searched.	n/a
Online resources and browsing	4	Describe any online or print source purposefully searched or browsed (e.g., tables of contents, print conference proceedings, web sites), and how this was done.	n/a
Citation searching	5	Indicate whether cited references or citing references were examined, and describe any methods used for locating cited/citing references (e.g., browsing reference lists, using a citation index, setting up email alerts for references citing included studies).	n/a
Contacts	6	Indicate whether additional studies or data were sought by contacting authors, experts, manufacturers, or others.	n/a
Other methods	7	Describe any additional information sources or search methods used.	n/a
SEARCH STRATEGIES			
Full search strategies	8	Include the search strategies for each database and information source, copied and pasted exactly as run.	Appendix 3
Limits and restrictions	9	Specify that no limits were used, or describe any limits or restrictions applied to a search (e.g., date or time period, language, study design) and provide justification for their use.	Appendix 3, p 6
Search filters	10	Indicate whether published search filters were used (as originally designed or modified), and if so, cite the filter(s) used.	n/a
Prior work	11	Indicate when search strategies from other literature reviews were adapted or reused for a substantive part or all of the search, citing the previous review(s).	n/a
Updates	12	Report the methods used to update the search(es) (e.g., rerunning searches, email alerts).	n/a

Dates of searches	13	For each search strategy, provide the date when the last search occurred.	Appendix 3, p 6
PEER REVIEW			
Peer review	14	Describe any search peer review process.	n/a
MANAGING RECORDS			
Total Records	15	Document the total number of records identified from each database and other information sources.	Fig 1
Deduplication	16	Describe the processes and any software used to deduplicate records from multiple database searches and other information sources.	Appendix 3

PRISMA-S: An Extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews
Rethlefsen ML, Kirtley S, Waffenschmidt S, Ayala AP, Moher D, Page MJ, Koffel JB, PRISMA-S Group.
Last updated February 27, 2020.

Appendix 3. Search strategy.

Search run on January 21, 2021 and updated on October 27, 2022. No date or language limits used. Duplication completed in EndNote X9 and Covidence.

Database	Search strategy	Number of results
PubMed	("Limited English Proficiency"[Mesh] OR "language barrier"[tiab] OR "language barriers"[tiab] OR "linguistic barriers"[tiab] OR "English proficiency"[tiab] OR "English proficient"[tiab] OR "language proficiency"[tiab] OR "communication barriers"[tiab] OR "Communication Barriers"[Mesh] OR "communication barrier"[tiab] OR "communication barriers"[tiab] OR "barrier to communication"[tiab] OR "language skills"[tiab] OR interpret[tiab] OR interprets[tiab] OR interpreted[tiab] OR interpreting[tiab] OR interpreter[tiab] OR interpreters[tiab] OR interpretation[tiab] OR translate[tiab] OR translates[tiab] OR translated[tiab] OR translating[tiab] OR translator[tiab] OR translators[tiab] OR translation[tiab] OR "Translating"[Mesh] OR "Translations"[Mesh]) AND ("Patient Readmission"[Mesh] OR "Patient Admission/statistics and numerical data"[Mesh] OR revisit[tiab] OR revisits[tiab] OR readmission[tiab] OR readmissions[tiab] OR "return visits"[tiab] OR "return visit"[tiab] OR "unscheduled emergency department visits")	1755
Embase (Embase.com)	('communication barrier'/exp OR 'interpreter service'/exp OR 'translation'/exp OR "language barrier":ti,ab OR "language	2525

	barriers":ti,ab OR "linguistic barriers":ti,ab OR "English proficiency":ti,ab OR "English proficient":ti,ab OR "language proficiency":ti,ab OR "communication barriers":ti,ab OR "communication barrier":ti,ab OR "communication barriers":ti,ab OR "barrier to communication":ti,ab OR "language skills":ti,ab OR interpret:ti,ab OR interprets:ti,ab OR interpreted:ti,ab OR interpreting:ti,ab OR interpreter:ti,ab OR interpreters:ti,ab OR interpretation:ti,ab OR translate:ti,ab OR translates:ti,ab OR translated:ti,ab OR translating:ti,ab OR translator:ti,ab OR translators:ti,ab OR translation:ti,ab) AND ('hospital readmission'/exp OR 'return visit'/exp OR revisit:ti,ab OR revisits:ti,ab OR readmission:ti,ab OR readmissions:ti,ab OR "return visits":ti,ab OR "return visit":ti,ab OR "unanticipated emergency department visits":ti,ab)	
Google Scholar	("english proficiency" OR "english proficient" OR "language barriers" OR "communication barriers" OR interpreters OR translators) AND (readmission OR revisits OR "return visits")	100
Total		4380
Total number of duplicates		1380
Total after de-duplication		**3000**

Appendix 4.

Table 4A. Study characteristics of studies with adult patients who are language discordant with their clinical teams compared to those who are not

Year	Author	Location	Study Design	Patient Population	Statistical Analysis	Number of participants [If available: n with language discordance/ total n (% w/ language discordance)]	Timeframe and Outcome	Result [Point estimate (95% CI) or frequency of outcome (%)]*	Quality: NOS (0-9)
Hospital readmission									
2010	Karliner	San Francisco, CA	Retrospective cohort study	Adult medicine inpatients	Logistic regression	1,146/7,023 (16%)	30-day readmission	Ref: English speakers 1) Non-English speakers: aOR=1.3 (1.0-1.7) 2) Chinese speakers: aOR=1.7 (1.2-2.3)** 3) Spanish speakers: aOR=1.5 (1.0-2.3)** 4) Russian speakers: aOR=0.8 (0.5-1.4)	8
2012	Bhalla	Bronx, NY	Retrospective cohort study	Adult inpatients	N/A	1) Acute MI: 1,924/6,074 (32%) 2) Heart failure: 1,969/9,245 (21%)	30-day readmission	1) Acute MI: Spanish preferred language: 277 (14%) vs English: 871 (20%) 2) Heart failure: Spanish preferred language: 565 (29%) vs English: 2,042 (28%)	7
2014	Black	USA	Retrospective cohort study	Adult medicine inpatients	N/A	Total n=19,049	1) Frequent 30-day readmission (3-5 inpatient stays)2) Very frequent 30-day readmission	1) Of those with frequent readmissions (≥6 inpatient stays), 16.5%** were non-English speaking and of those with very frequent readmissions (3-5 inpatient stays), 15.2% were non-English speaking, compared to those who had 1-2 inpatient stays,	7

							(≥ 6 inpatient stays)	of which 13.2% were non-English speaking	
2014	Regalbuto	New York, NY	Retrospective cohort study	Adult inpatients admitted for decompensated heart failure	Cox proportional hazards	45/145 (31%)	30-day readmission	Non-English primary language vs English primary language: HR=2.2 (p=0.052)	6
2015	Wasfy	Boston, MA	Case-control study	Adult inpatients admitted for PCI	Logistic regression	164/2,664 (6%)	30-day readmission	Interpreter needed vs not needed: aOR=1.39 (0.99-1.95)	8
2016	Wilbur	Baltimore MD	Retrospective cohort study	Adult surgical gynecologic oncology inpatients	Logistic regression	58/1605 (4%)	30-day readmission	Language discordant vs not language discordant: aOR =3.36 (1.01-11.15)**	7
2017	Karliner	San Francisco, CA	Non-randomized experimental study	Adult medicine inpatients	Logistic regression	1,963/8,077 (24%)	30-day readmission	1) Pre-intervention (LEP vs EP): aOR=1.07 (0.85-1.35); 2) Intervention (LEP vs EP): aOR=0.64 (0.43-0.95)** 3) Post-Intervention (LEP vs EP): aOR=1.09 (0.80-1.48)	8
2019	Chan	San Francisco, CA	Retrospective cohort study derived from RCT	Adult medicine inpatients	Logistic regression	251/674 (37%)	30-day readmission	LEP vs EP: aOR=1.38 (0.84-2.26)	8
2020	Beagley	Melbourne, Australia	Retrospective cohort study	Adult inpatients	N/A	1) Born in non-English speaking countries: 1,191,243/ 2,674,357[a] (45%)	30-day readmission	Percentage differential readmission rate of patients born in non-English speaking countries vs in English-speaking countries: median (range)= 1.6% (-5.9% to 3.4%)	7

						2) Interpreter mediated: 479,618/ 2,674,357[a] (18%)			
2020	Biswas	Victoria, Australia	Retrospective cohort study	Adult patients who had PCI for STEMI	Logistic regression	430/5,385 (8%)	30-day readmission	LEP vs: EP: aOR=2.01 (1.21-3.36)**	5
2020	Fazzalari	Central MA	Retrospective cohort study	Adult inpatients with cholecystitis	Poisson regression	38/203 (19%)	30-day readmission	Interpreter needed vs not needed: aOR=0.20 (0.04-1.05)	7
2021	Rambachan	San Francisco, CA	Retrospective cohort study	Adult medicine inpatients	Logistic regression	2,893/18,808 (15%)	7-day readmission	LEP vs EP: aOR=0.88 (0.80-0.97)**	8
2021	Schaefer	Boston, MA	Retrospective cohort study	Adult women who had nulliparous, term, singleton, vertex deliveries	Poisson regression	1,159/11,298 (10%)	30-day maternal readmission	LEP vs EP: aRR=1.1 (0.57-2.2)	7
2022	Abedini	Seattle, WA	Retrospective cohort study	Community-based adults (65+) who died between 2010-2018	Logistic regression	1,363/18,490 (7%)	30-day readmission (within last 90- and last 180-days of life)	1) Within last 90-day of life (LEP vs EP): aOR=1.64 (1.30-2.07)** 2) Within last 180-days of life (LEP vs EP): aOR=1.44 (1.16-1.78)**	9
2022	Manuel (craniotomy)	San Francisco, CA	Retrospective cohort study	Adult inpatients undergoing craniotomy	Logistic regression	150/2,232 (7%)	30-day readmission	LEP vs EP: aOR=0.84 (0.45-1.56)	6
2022	Manuel (arthroplasty)	San Francisco, CA	Retrospective cohort study	Adult inpatients undergoing total joint arthroplasty	Logistic regression	378/4,721 (8%)	30-day readmission	LEP vs EP: aOR=0.80 (0.49-1.28)	6

2022	Maurer	Boston, MA	Retrospective cohort study	Adult inpatients on trauma service	Logistic regression	921/12,562 (7%)	30-day readmission	LEP vs EP: aOR=1.08 (0.87-1.35)	9
2022	Miteva	Zurich, Switzerland	Case-control study	Adult inpatients in psychiatric hospital	Logistic regression	2,102/4,202 (50%)	1-year readmission	1) Low language proficiency: 763 (36.3%) 2) High language proficiency: 710/2101 (33.8%)	8
2022	Squires	New York, NY	Retrospective cohort study	Adults receiving care from home health agency	Marginal Structural Model	22,103/90,221 (24%)	30-day readmission	LEP vs EP: aOR=1.011 (1.004-1.018)**	9
Hospital readmission and ED revisit									
2015	Lopez	Boston, MA	Retrospective cohort study	Adult medicine inpatients	Logistic regression	564/4,224 (13%)	30-day readmission and 30-day ED revisit	Ref: English speakers 1) No interpretation services used during hospitalization: -Readmission: aOR=0.86 (0.62-1.19) -ED revisit: OR=0.81 (0.63-1.04) 2) Interpretation service used by hospitalist: -Readmission: aOR=1.07 (0.46-2.52) -ED revisit: aOR=1.64 (0.65-4.12) 3) Interpretation service used by non-hospitalist physician: -Readmission: aOR=0.78 (0.40-1.52) -ED revisit: aOR=1.01 (0.56-1.81) 4) Interpretation service used by non-physician:	8

								-Readmission: aOR=0.91 (0.53-1.58) -ED revisit: aOR=1.08 (0.67-1.73)	
2016	Narula	Boston, MA	Retrospective cohort study	Adults undergoing colectomy	Logistic regression	70/1,078 (7%)	30-day readmission and 30-day ED revisit	1) Readmission (LEP vs EP): aOR=1.73 (0.97-3.05) 2) ED revisit (LEP vs EP): aOR=3.0 (1.68-5.45)**	5
2017	Inagaki	Boston, MA	Retrospective cohort study	Adults undergoing nonemergent infrainguinal bypass	Logistic regression	51/261 (20%)	30-day readmission and 30-day ED revisit	1) Readmission (non-English-speaking vs English-speaking): aOR=1.51 (0.77-2.95) 2) ED revisit (non-English-speaking vs English-speaking): aOR=1.28 (0.58-2.83)	7
2019	Rawal	Ontario, Canada	Retrospective cohort study	Adult inpatients	Log-link binomial generalized linear regression	2,336/9,881 (24%)	30- and 90-day day readmission and 30-day ED revisit	1) 30-day readmission (LEP vs EP) -COPD: aRR=1.51 (1.11-2.06)** -Pneumonia: aRR=1.00 (0.77-1.31) -Heart failure: aRR=1.29 (1.08-1.54)** -Hip fracture: aRR=1.05 (0.64-1.74) 2) 90-day readmission (LEP vs EP) -COPD: aRR=1.32 (1.06-1.65)** -Pneumonia: aRR=1.02 (0.84-1.23) -Heart failure: aRR=1.24 (1.09-1.40)** -Hip fracture: aRR=1.23 (0.88-1.72) 3) 30-day ED revisit (LEP vs EP) -COPD: aRR=1.25 (0.95-1.66) -Pneumonia: aRR=1.11 (0.89-1.40) -Heart failure: aRR=1.32 (1.12-1.55)** -Hip fracture: aRR=1.12 (0.76-1.66)	9

2020	Seman	Melbourne, Australia	Retrospective cohort study	Adults admitted for heart failure	Cox proportional hazard	542/1,613 (34%)	30-, 180-, and 365- day readmission and 30-, 180-, and 365-day ED revisit	1) All-cause readmission (CALD-LEP vs EP): aHR=1.07 (0.94-1.22) 2) Heart failure-related readmission (CALD-LEP vs EP): aHR=1.24 (1.04-1.49)** 3) ED revisit: HR=1.30 (1.13-1.51)**	7
2022	Seale	Ontario, Canada	Retrospective cohort study	Adults receiving publicly-funded long-term home care services	Logistic regression	30,069/189,690 (16%)	30-day readmission and 30-day ED revisit	Ref. Anglophone 1) Readmission (Allophone): aOR=1.23 (0.95-1.60) 2) Readmission (Francophone): aOR=1.05 (0.87-1.26) 3) ED revisits (Allophone): aOR=1.20 (0.95-1.51) 4) ED revisits (Francophone): aOR=0.99 (0.85-1.16)	9
2022	Stolarski	Boston, MA	Retrospective cohort study	Adult inpatients undergoing bariatric surgery	Logistic regression	671/1,662 (40%)	30- day and 1-yr readmission; 30-day and 1-yr ED revisits	1) 30-day readmission (LEP vs EP): aOR=1.01 (0.58-1.71) 2) 1-year ED revisit (LEP vs EP): aOR=0.65 (0.43-0.95)** 3) 1-year readmission (LEP vs EP): aOR=0.94 (0.56-1.55)	6
ED revisit									
2016	Ngai	New York City, NY	Retrospective cohort study	Adult patients seen in ED	Generalized estimating equation models	2,282/32,857 (7%)	72-hour ED revisit	LEP vs EP: aOR=1.24 (1.02-1.53)**	8
2018	Schulson	Boston, MA	Retrospective cohort study	Adult patients seen in ED	Logistic regression	5,241/57,435 (9%)	72-hour ED revisit	LEP vs EP: aOR=0.98 (0.73-1.33)	7

2020	Feeney	Boston, MA	Retrospective cohort study	Adult surgical oncology inpatients	Logistic regression	824/2,467 (33%)	30-day ED revisit	LEP vs EP: aOR=1.08 (0.75-1.53)	8
2021	Hutchinson* *includes pediatrics	Sydney, Australia	Retrospective cohort study	Patients of all ages seen in ED	N/A	27,421/115,666 (24%)	28-day ED revisit	1) English: Return patient 3625 (76.1%) vs. Non-return patient 84,561 (76.2%) 2) Arabic: Return patient 180 (3.8%) vs. Non-return patient 3073 (2.8%)** 3) Mandarin: Return patient 123 (2.6%) vs. Non-return patient 2737 (2.5%) 4) Italian: Return patient 94 (2.0%) vs. Non-return patient 2195 (2.0%) 5) Culturally and linguistically diverse: Return patient 1131 (23.8%) vs Non-return patient 26,290 (23.7%)	7
2021	Wong	Boston, MA	Retrospective cohort study	Adult inpatients undergoing colorectal surgery	Logistic regression	117/1,763 (7%)	30-day ED revisit	1) Nonpreventable revisit (LEP vs EP): aOR=2.65 (1.32-5.32)** 2) Preventable revisit (LEP vs EP): aOR=3.6 (1.64-7.92)**	6
2022	James	Gainesville, FL	Retrospective cohort study	Adult patients seen in ED	N/A	466/768 (67%)	9-day ED revisit	1) DHH ASL: 46 (10.3%), 95% CI (7.7%–13.5%) 2) DHH English-speakers: 172 (11.3%), 95% CI (9.8%–13.0%) 3) Non-DHH English speakers: 64 (7.8%) 95% CI (6.6%–10.6%)	6

Table 4B. Study characteristics of studies with pediatric patients with parents who are language discordant with their child's clinical teams compared to those who do not

Year	Author	Location	Study Design	Patient Population	Statistical Analysis	Number of participants [If available: n with language discordance/ total n (% w/ language discordance)]	Timeframe and Outcome	Result [Point estimate (95% CI) or frequency of outcome (%)]*	Quality: NOS (0-9)
Hospital readmission									
2006	Young	Ontario, Canada	Non-randomized experimental study	Pediatric outpatients receiving tele-homecare	N/A	15/50 (30%)	8 week-readmission	1) 8 (50%) of patients with multiple readmissions had language discordance 2) 7 (21%) of patients without readmissions had language discordance	3
2016	Eneriz-Wiemer	Palo Alto, CA	Retrospective cohort	Pediatric outpatients and inpatients with preterm birth or very low birth weight	Logistic regression	433/1,541 (28%)	30-day readmission	Non-English primary language vs English primary language: aOR=0.78 (0.53-1.14)	6
2017	Ju	Palo Alto, CA	Retrospective cohort	Pediatric inpatients	Logistic regression	17,754/67,473 (26%)	7- and 30-day readmission	1) 7-day readmission (LEP vs EP): aOR=0.99 (0.88-1.13) 2) 30-day readmission (LEP vs EP): aOR=0.96 (0.87-1.07)	9
2021	Yeh	Los Angeles, CA	Cross-sectional study	Pediatric patients admitted to NICU	Logistic regression	104/169 (67%)	12 month-readmission	English vs non-English: aOR=1.91 (0.68-5.39)	3
2021	Zhou	Western Australia	Retrospective cohort study	Pediatric inpatients	Logistic regression	24/940 (3%)	30-day readmission	1) LEP: 14 (58%) 2) EP: 456 (50%)	8
ED revisit									
2013	Gallagher	Boston, MA	Retrospective cohort	Pediatric patients seen in ED	Logistic regression	14,053/119,782 (12%)	72-hour ED revisit	LEP vs EP: aOR=1.43 (1.23-1.66)**	8

2016	Saunders	Ontario, Canada	Retrospective cohort	Pediatric patients seen in ED	Logistic regression	429,113/509,519 (84%)	7-day ED revisit	Ref: English native tongue 1) French: aOR=0.99 (0.85-1.15) 2) Not English or French: aOR=1.05 (1.01-1.09)**	8
2017	Samuels-Kalow	Boston, MA	Prospective cohort	Pediatric patients seen in ED	Logistic regression	46/202 (23%)	72-hour ED revisit	Spanish-speaking families vs English-speaking families: aOR=3.49 (1.02-11.90)**	7
2019	Greenky	Atlanta, GA	Retrospective cohort	Pediatric patients seen in ED	Logistic regression	18,572/152,945 (12%)	7-day ED revisit	1) Interpreter requested vs no interpreter requested: aOR=1.03 (0.98-1.09) 2) Spanish interpreter vs non-Spanish interpreter: aOR=1.08 (0.96-1.21)	9
2020	Poel	Aurora, CO	Non-randomized experimental study	Pediatric outpatient	N/A	875/12,060 (7%)	30-day ED revisit	1) Rate of revisit per 1000 inhaler prescription [median (25^{th}, 75^{th} percentile)]: Spanish: 43 (0,69) compared to English: 39 (28,50)	6
2021	Martinez	VA	Non-randomized experimental study	Pediatric patients seen in ED	N/A	4,987/154,067 (3%)	48-hour ED revisit	LEP 1) Baseline: 30 (3.0%) 2) Interventions 1 and 2: 96 (2.9%) 3) Intervention 3: 26 (3.7%) EP 1) Baseline: 978 (2.8%) 2) Interventions 1 and 2: 2482 (2.7%) 3) Intervention 3: 479 (2.3%)	6
2021	Portillo	Boston, MA	Retrospective cohort study	Pediatric patients seen in ED	Logistic regression	12,986/63,601 (20%)	72-hour ED revisit	1) Revisits resulting in discharge (LEP vs EP): aOR=1.15 (1.01-1.30)** 2) Revisits resulting in hospitalization (LEP vs EP): aOR=1.28 (1.03-1.58)**	8

Table 4C. Study characteristics of studies with only patients who are language discordant with their clinical teams

Year	Author	Location	Study Design	Patient Population	Intervention Description	Statistical Analysis	Number of participants [n with intervention / total n (% of total n that received intervention)]	Time Frame and Outcome	Result [Point estimate (95% CI) or frequency of outcome (%)]	Quality: NOS
Hospital readmission										
2012	Lindholm	Worcester, MA	Retrospective cohort	Adult inpatients	Provision of interpreter	Logistic regression	1) Interpreter on admission and discharge: 1192/3071 (39%) 2) Interpreter on discharge but not admission: 482/3071 (16%) 3) Interpreter on admission but not discharge: 963/3071 (31%) 4) Interpreter neither on admission or discharge: 423/3071 (14%)	30-day readmission	Ref: Interpreter neither on admission or discharge 1) Interpreter on admission and discharge: aOR=0.67 (p-value <0.01)** 2) Interpreter on discharge but not admission: aOR=0.69 (p-value 0.03)** 3) Interpreter on admission, but not discharge: aOR 0.59 (p<0.01)**	8
2019	Abbato	Brisbane, Australia	Retrospective cohort study	Adult inpatients	Provision of interpreter	Logistic regression	173/448 (39%)	30-day readmission	Ref: No interpreter in either ED or inpatient ward:	7

									1) Interpreter in ED but not inpatient ward: aOR=0.46 (0.16-1.33) 2) No interpreter in ED but interpreter in inpatient ward: aOR=1.63 (0.87-3.08) 3) Interpreter in both ED and inpatient ward: aOR=2.32 (0.55-9.71)	
2019	Blay	Sydney, Australia	Retrospective cohort study	Adult inpatients	Provision of interpreter	N/A	526/3,074 (17%)	28-day readmission	Among those readmitted, interpretation service provided: 123/829 (14.8%)	5
2022	Shiner	Sydney, Australia	Retrospective cohort study	Adult inpatients for subacute rehabilitation	Provision of interpreter	N/A	42/85 (49%)	6-month readmission	Interpreter: 15 (35.7%) No interpreter: 25 (58.1%)**	5
Hospital readmission and ED revisit										
2017	Aguayo-Rico	New Mexico, USA	Non-randomized experimental study	Adult inpatients	Updated discharge instruction template for Spanish speakers	N/A	10/62 (16%)	30-day readmission and 30-day ED revisit	After implementation of updated Spanish discharged instruction template: 1) Readmission: 0/10 (0%) 2) ED revisit 2/10 (20%)	3

Abbreviations: CI=Confidence Interval; OR=Odds Ratio; aOR= adjusted Odds Ratio; HR=Hazards Ratio; DHH=deaf/hard of hearing; PCI= percutaneous coronary intervention; STEMI= ST elevation myocardial infarction; NICU=neonatal intensive care unit, Ref= reference group; CALD-LEP: Culturally and linguistically diverse patients with limited English proficiency

[a]Sample size refers to patient occasions of services (OOS)

*Odds Ratio compares odds of outcome among those with non-dominant language preference to those without non-dominant language preference

**Denotes statistical significance at p-value <0.05

Appendix 5. Proportion of studies with high NOS quality assessment scores.