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# Broadcasting News and Emergency Information to Non-English Speakers

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## Abstract

Television and radio have long been the primary means of disseminating emergency information in the U.S. However, this system does not always reach individuals with limited English proficiency (LEP), and can leave their lives at risk. This paper uses TV and radio data, census data, and disaster risk data, and estimates that the number of LEP individuals who are not served by broadcasters in their native language exceeds two million. Moreover, those who remain unserved may not be who policymakers and emergency planners expect. While many focus on Spanish-speakers, there are large numbers of unserved LEP individuals who speak other languages as well, such as Korean and Vietnamese, who have lower access to broadcasts in their language. Geographically, many who remain unserved live outside of the cities with the largest concentrations of immigrants. Thus, it is important to supplement broadcasting with technology such as smartphones or social media that are conducive to disseminating information in less common languages and to LEP communities that are more dispersed. Additionally, while AM radio and full-power TV are the most important media for reaching LEP individuals, on the order of 100 thousand are served by low-power TV (LPTV) alone, and are in danger of losing access to broadcasts in their own language if LPTV stations were to cease operation.

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# 1 Introduction

Giving everyone access to local sources of news and information in a language they understand has many benefits, from building cohesive communities to helping voters make informed decisions. It is even more important when hurricanes or earthquakes hit, and lives depend on access to this information. In the U.S., TV and radio broadcasting are the primary methods for disseminating emergency information during a disaster. This is in part because regulations require broadcasters to serve their communities to get and keep their broadcasting licenses, and providing emergency information is one way to do so. Additionally, over-the-air broadcasts may be more effective in cases when there is limited access to electrical outlets, people are displaced, and when print media is too slow and may be prevented from circulating. However, most of these broadcasts are in English. As a result, some of the roughly 25 million people in the U.S. with limited English proficiency (LEP) [CENS14] may not receive the information they need.

There are several ways to bring emergency information to more LEP individuals. For example, the Federal Communications Commission (FCC) has been actively considering new regulations that require broadcasters to provide information in languages other than English in certain regions and under certain conditions [FCC16a]. Modern technologies, such as social media or smart phone applications, may also be used for this purpose. However, it is difficult to know the importance of adopting new approaches, without understanding the extent of the problem. After all, many U.S. broadcasters transmit in languages other than English, and some LEP individuals have plenty to choose from. Moreover, if we are to devise new or better approaches to reach more LEP individuals, we must first understand how well LEP individuals are served by today's broadcasters, and characterize the LEP individuals who are not well-served.

One goal of this paper is to understand better the number of broadcasters that can serve LEP individuals in the U.S. today in his or her native language. While LEP individuals who are not served by any broadcasters are a major concern, those served by only a small number may still be vulnerable. For example, many listeners on the Gulf coast of the U.S. were served effectively by a single Spanish-language station in the days before Hurricane Katrina arrived in 2005. However, this station was damaged in the hurricane, and, from that moment on, there were no Spanish-language TV or radio stations operating in the area [MMTC14].

To better focus on areas of need, we need to identify the languages used by LEP individuals who are not able to receive any broadcasts in their native language. While Spanish is the first language of a large majority of LEP individuals in the U.S. [CENS14], it is also the most common language after English among broadcasters. As such, it is not necessarily the language with the greatest need. To examine the variation in coverage across languages, we focus on five languages, ranging from the widely-spoken (Spanish and Chinese) to the relatively uncommon (Hindi), with two in between (Vietnamese and Korean).

This paper will also investigate where unserved LEP individuals are located. We investigate both which regions would benefit most from dissemination of information in languages other than English, and how concentrated unserved LEP individuals are. While the former provides information on where new solutions may be useful, the latter helps us to understand the degree to which broadcast solutions can be effective. TV and radio broadcasting tend to be cost effective for reaching large numbers of individuals who are concentrated around a broadcast tower, but these technologies are

not cost-effective when the same number of individuals are dispersed over areas much larger than a single broadcaster can serve. Understanding geographic concentration helps guide our understanding of whether other technologies to reach unserved individuals may be needed.

A final goal is to examine which types of broadcast media are more important for reaching LEP individuals. Regulators may place different requirements on different media, and relief agencies may stock receivers that work with some media but not others. We consider four types of media: FM radio, AM radio, full-power television (FPTV) and low-power television (LPTV). It is particularly important to understand the contributions of LPTV, as many LPTV stations may cease operations, depending upon the outcomes of the FCC's upcoming incentive auction for spectrum and subsequent spectrum repacking [FCC12]. Although LPTV stations use spectrum more efficiently than FPTV, as recently shown [BETT15], LPTV spectrum licenses do not generally carry the same rights as FPTV spectrum licenses, and this policy makes LPTV stations more vulnerable to elimination. This paper will investigate how the loss of LPTV might increase the number of LEP individuals who are unserved in their native language.

Section 2 will describe our data sources and analytic methodology in greater detail. Section 3 characterizes the LEP population in the U.S., including the languages spoken, geographic distribution, and likelihood of being in a region that is prone to natural disaster. Section 4 presents the results of our analysis on how well LEP individuals are served by broadcasters in their own language. Our conclusions are presented in Section 5.

# 2 Data Sources and Method

## 2.1 Data sources

Size, location, language-spoken, and English-proficiency of LEP populations for most of the analysis were extracted at the census-tract level from the 2010-2014 American Community Survey 5-year estimates, B16001: Language spoken at home by the ability to speak English for the population 5 years and older. The same data were extracted at the county-level from the 2009-2013 American Community Survey for analysis that was performed earlier to compare against disaster data (see below) Individuals were considered to have Limited-English Proficiency if they spoke English at a level lower than "Very Well," consistent with the U.S. Census Bureau's definitions of Limited-English Proficiency. The census data was pulled from the National Historical Graphical Information System (NHGIS) which combines the data with geographic shape files for use in the mapping software, ArcGIS.

Categorization of radio stations, both FM and AM, as broadcasters of specific languages was performed in a multi-step process. An initial list of radio stations was identified using BIA/Kelsey's 2014 *Investing in Radio Market Report* based on the radio station's indicated format, e.g., "Spanish" or "International."[3] The broadcast language of the radio stations was then verified either by locating the radio station's website or by calling the station. Stations that broadcast in multiple languages were included as a broadcaster for all of the languages in which they broadcast. While AM stations

[3] Full list of included BIA/Kelsey formats include: Asian, Ethnic, French, Greek, Grupero, Hawaiian, Hurban, International, Japanese, Korean, Latino, Mexican, Norteno, Polish, Polka, Portuguese, Ranchera, Raggaeton, Romantic, Spanish, Spanish AC, Spanish News, Tejano, and Tropical

are categorized for all the languages considered in this paper, FM stations were only categorized for Spanish as the listed formats for the other languages were not sufficiently precise.

Coverage areas for FM and AM radio stations were sourced from the FCC, through slightly different processes. Coverage areas for FM stations were sourced from the FCC's comprehensive data set of FM coverage areas included in their FM Service Counter Data Points [FCC14a], accessed in November 2014. The size of the areas was estimated assuming a field strength of 54-60 dBu (approximately 1 mV/m), which was the FCC default. Coverage areas for AM stations were sourced from the FCC's AM Query [FCC16b] for each station independently, as no comprehensive data set was readily available. The AM data was accessed in May 2016. The FCC provides two potential coverage areas, based on field strengths of 0.5 mV/m and 2 mV/m – the larger of these two coverage areas was used in our analyses, which leads to a potential upper bound in our assessments of coverage.

Categorization of television stations as broadcasters of specific languages involved a more extensive process of validation. Each television station listed in the BIA/Kelsey's 2014 *investing in Television Market Report* was included if it was affiliated with a non-English network or if the station was identified as Independent-Spanish or Independent-Asian. Listings from SNL Kagan's report on Media and Communications [SNL14], including its sections on ethnic, multicast stations and station information from the website Rabbitears.info [RABB14] were used to supplement and validate the BIA/Kelsey data. Categorization of television stations were performed for Spanish, Korean, Vietnamese, and Hindi.

Coverage areas for television stations was sourced from the FCC's TV Service Contour Data Points [FCC14b], accessed in November 2014. The size of the areas was estimated using the FCC default field strength which range from 28-41 dBu for DTV and 47-64 dBu for NTSC stations, depending upon the channel. Broadcast areas are determined by over-the-air coverage boundaries. In reality, some LEP individuals may access these stations through cable TV or satellite TV providers. At least for FPTV, the over-the-air coverage area is generally similar to the area served when a TV station's signal is retransmitted over cable or satellite TV, although the areas are not identical. Disaster frequency was estimated using the U.S. Federal Emergency Management Association's (FEMA) data files on Presidential Disaster Declarations [FEMA14], which include the number of presidentially declared disasters by county over a 50-year time-frame, 1964-2013, and includes both natural and man-made disasters.[4] Such declarations must be requested by state governors, and doing so makes federal funding available for emergency relief and reconstruction.

Disaster severity was estimated using the University of South Carolina's Spatial Hazard Events and Losses Database (SHELDUS) [HVRI14], which include crop and property damage at a county level, from 1960-2009, and includes natural disasters only[5]. SHELDUS itself is sourced from the National Climactic Data Center (NCDC). Crop and property damage values may be reported as a range in SHELDUS and the low end of the range is used as a lower-bound estimate of economic losses.

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[4] Main types of disaster include: biological, chemical, coastal storm, dam/levee break, drought, earthquake, fire, fishing losses, flood, freezing, human cause, hurricane, mud/landslide, severe ice storm, severe storm, snow, terrorist, tornado, toxic substances, tsunami, typhoon, and volcano.

[5] Types of disaster include: avalanche, coastal, drought, earthquake, flood, fog, hail, heat, hurricane/tropical storm, landslide, lightning, severe thunderstorm, tornado, tsunami/seiche, volcano, wildfire, wind, winter weather

## 2.2 Analysis

Integration of the data sets was performed using ArcGIS Pro 1.0. Census tract and county boundaries were provided by NHGIS's shapefiles. Coverage areas provided by the FCC were mapped directly into ArcGIS. FEMA and SHELDUS data was associated with the county-level boundaries by matching county data by the Federal Information Processing Standard (FIPS) code for the county.

Media coverage of LEP populations was estimated using one of two methodologies, the specific methodology used will be noted in the discussion of results.

*Apportioned* estimates calculate the total number of individuals covered by first calculating the percent of a census tract area that intersects with a broadcast area, and then multiplying that percentage by the LEP population in the census tract. A similar approach is applied to account for multiple broadcasts. For example, if two broadcasters intersect in a census tract, the area where the broadcasts intersect in the census tract is divided by the area of the census tract and multiplied by the LEP population to estimate the number of individuals covered by two broadcasts. This approach assumes that LEP populations are uniformly distributed within a census tract, and can over- or under- estimate coverage if LEP populations are concentrated within a specific part of the tract.

*Binary/upper-bound* estimates calculate the total number of individuals covered by first determining whether or not a tract intersects with any broadcast areas. If an intersection exists, the tract is considered "covered" regardless of the area of coverage. Population estimates derived from this process consider all LEP individuals in a covered area to be covered. These estimates do not differentiate between tracts that are covered by one or multiple broadcasts and simply categorize tracts as either covered or not covered. This approach presents an upper-bound estimate of coverage for both tracts and population estimates.

# 3 LEP Population in the U.S. Today

According to the 2014 American Community Survey, the total population of LEP individuals in the United States is 24.3 million, which comprises 8.6% of the total United States population. Five-year growth between 2009 and 2014 in the population of LEP individuals is 5.2%, which slightly outpaces the growth of the overall US population at 4.8%.

## 3.1 Size and growth of LEP populations by language

The largest group of LEP individuals are comprised of those who speak Spanish at home, which includes 16.4 million individuals. This is followed by Chinese at 1.7 million, Vietnamese at 850 thousand, Korean at 620 thousand, and Tagalog at 525 thousand. Table 1 provides details on the populations of LEP individuals larger than 125k. The fastest growing populations of LEP individuals from 2009 to 2014, for which a language at home is specified, are made up of those who speak Arabic (36.4%), Hindi (26.0%), Urdu (23.4%), Gujarati (22.4%) and Chinese (22.2%). While the total number of Spanish-speaking LEP individuals indicates that Spanish, as a language, may deserve particular attention, the population of LEP individuals who speak other languages are also sizable and many of these populations are growing more rapidly.

*Table 1. Languages spoken by populations of LEP individuals over 125, based on 2014 and 2009 ACS.*

| Language spoken at home | Total population | LEP | 5-year growth in LEP (2014 vs 2009) |
|---|---|---|---|
| Spanish or Spanish Creole | 76,197,396 | 16,346,401 | 2.3% |
| Chinese | 5,979,570 | 1,659,508 | 22.2% |
| Vietnamese | 2,854,388 | 850,087 | 16.6% |
| Korean | 2,252,712 | 620,149 | 4.3% |
| Tagalog | 3,292,220 | 525,392 | 15.1% |
| Russian | 1,779,414 | 414,793 | -2.7% |
| Arabic | 1,962,140 | 366,927 | 36.4% |
| Other Indic languages | 1,696,284 | 336,486 | 39.3% |
| French Creole | 1,531,884 | 328,484 | 21.5% |
| Other Asian languages | 1,933,086 | 299,840 | 56.8% |
| African languages | 1,879,100 | 298,367 | 28.9% |
| French (incl. Patois, Cajun) | 2,583,726 | 261,458 | -10.4% |
| Portuguese or Portuguese Creole | 1,373,504 | 260,335 | -12.1% |
| Polish | 1,147,950 | 229,514 | 0.9% |
| Japanese | 896,886 | 191,272 | 0.8% |
| Italian | 1,378,296 | 184,486 | 0.7% |
| German | 2,058,444 | 166,129 | 0.7% |
| Other Pacific Island languages | 854,536 | 164,402 | 0.6% |
| Other Indo-European languages | 907,734 | 160,090 | 0.6% |
| Persian | 795,602 | 148,184 | 0.6% |
| Hindi | 1,342,424 | 139,877 | 0.6% |
| Gujarati | 753,730 | 133,147 | 0.5% |

## 3.2 Location and concentration of LEP populations

Generally, the percentage of the total population that is LEP is higher in states along the southern US border and in states with larger cities. Of the 48 contiguous states, the states with the largest population of LEP individuals are California (6.8 million, 19.1% of population), Texas (3.4 million, 14.2 %), New York (2.5 million, 13.5%), Florida (2.1 million, 11.7%), and Illinois (1.1 million, 9.3%). Table 2 include a summary of the states with over 1 million LEP individuals.

*Table 2. Contiguous US states with populations of LEP individuals over 1M, 2014 ACS.*

| State | Total LEP population | LEP percent total pop. | Languages with over 50k LEP speakers |
|---|---|---|---|
| California | 6,789,522 | 19.1% | Spanish - 4.5M; Chinese - 610k; Vietnamese - 316k; Tagalog - 260k; Korean - 219k; Armenian - 94k; Other Indic - 74k; Persian - 74k; Russian - 73k; Japanese - 63k; Arabic - 63k |
| Texas | 3,435,260 | 14.2% | Spanish - 3.0M; Vietnamese - 116k; Chinese - 71k |
| New York | 2,481,513 | 13.5% | Spanish - 1.2M; Chinese - 351k; Russian - 130k; Other Indic - 80k; French Creole - 69k - Korean - 62k - Italian - 58k; Yiddish - 53k |
| Florida | 2,136,685 | 11.7% | Spanish - 1.6M; French Creole - 173k |
| Illinois | 1,122,349 | 9.3% | Spanish - 694k; Polish - 90k; Chinese - 53k |
| New Jersey | 1,034,428 | 12.4% | Spanish - 598k; Chinese - 52k |

A comparison of the languages in each state suggests that the nature of LEP populations can vary from region to region. While Spanish is the most common language across the states, the second most common language in the states varies, including Chinese, Vietnamese, French Creole, and Polish. Moreover, states vary in terms of the variety of languages spoken. For example, there are only 3 languages spoken by over 50 thousand LEP individuals in Texas, whereas there are 8 languages spoken by over 50 thousand LEP individuals in New York, despite New York having fewer LEP individuals.

How geographically concentrated individuals are can help indicate how well broadcast-based solutions can serve LEP individuals. Figure 1 suggests that the more common the language spoken by the LEP populations, the more concentrated the populations appear to be. For example, 85% of Spanish-speaking LEP individuals live in census tracts where over 5% of the population are Spanish-speaking LEP individuals; only about 2% live in regions where less than 1% are Spanish-speaking LEP individuals. In contrast, 48% of Hindi-speaking LEP individuals live in regions where Hindi-speaking LEP individuals are low (< 1%); and only 4% live in regions where the concentration of Hindi-speaking LEP individuals are relatively high (> 5%). Such a pattern suggest that different solutions may be necessary for the different LEP populations.

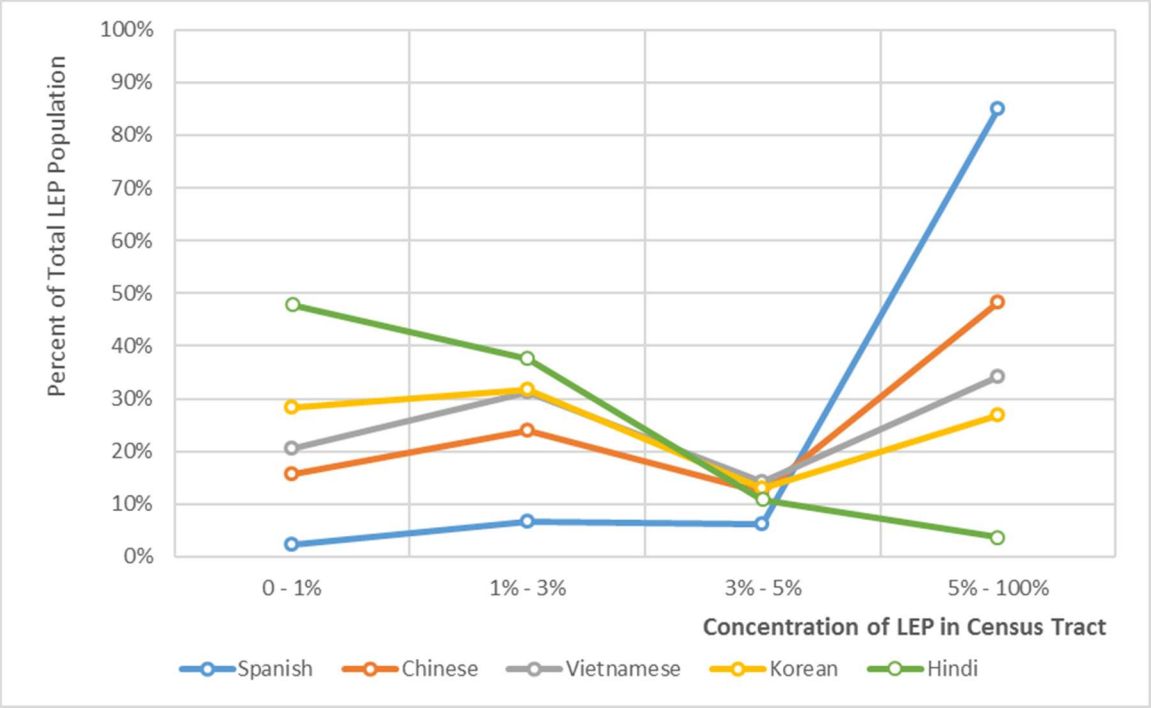


*Figure 1. Concentration of LEP Individuals by Census Tract*

## 3.3 Risk of natural disasters

Our analysis shows that LEP individuals are more likely to live in areas that historically have more disasters. Bridging the 2013 ACS with FEMA's data on the number of presidentially declared disasters from 1964-2013, Figure 2 shows the percentage of both the general and LEP populations (including only Spanish, Chinese, Korean, Vietnamese and Hindi) that live in counties that have endured from 0 to over 20 declared disasters. We observe that LEP individuals tend to live in areas of higher disaster risk than the general population. For example, approximately 25% of LEP individuals live in counties with over 20 declared disasters, contrasted with just 12% of the general US population.

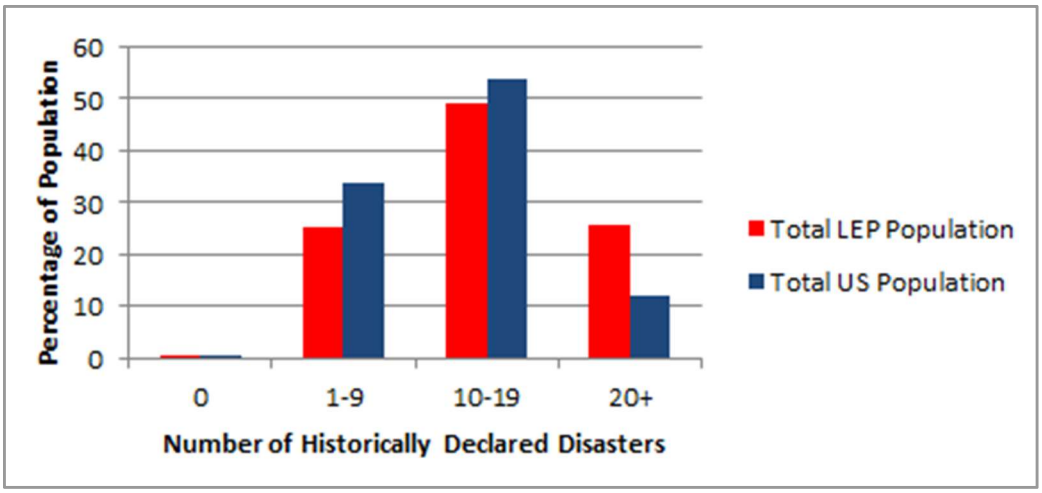


*Figure 2. Disaster history of counties in which LEP and overall US population live*

In contrast, LEP individuals do not appear to live in areas where the economic losses as a result of disasters are more severe. Bridging the 2013 ACS with the SHELDUS database on economic losses, we find that the population of LEP individuals living in areas where economic losses exceeds $1000 per capita is 10% relative to 20% of the general US population.

Overall, the population of LEP individuals in the US is both substantial and diverse. LEP populations appear to be more greatly concentrated in areas where higher immigration is expected – such as larger cities and southern states – but also coincide with areas where disasters may be more frequent – if not more severe.

# 4 Results

## 4.1 Media Comparison

Figure 3 shows the percentage of LEP individuals from various language groups who are currently served by broadcasters in each of the major media. In general, AM radio and FPTV are particularly important for reaching LEP individuals. LPTV and FM radio also contribute, but less so. For example, only 91.1% of LEP Spanish-speakers receive AM broadcasts in Spanish, and 90.2% receive FPTV broadcasts in Spanish. In contrast, only 75.2% and 69.1% receive Spanish LPTV and FM broadcasts, respectively. These results also suggest that our lack of data on FM radio, as discussed in Section 2.1, will probably have a limited effect on our results as long as our data on AM radio and FPTV are reasonably complete.

Figure 3 also shows that some language groups are much better served than others, and that this appears to be related to the number of individuals who speak that language. For example, Spanish is the most widely spoken language in the U.S. after English, and AM reaches 91.1%of LEP Spanish-speakers, while only 27.0% of those who speak the relatively uncommon language of Hindi can receive AM broadcasts in their native language. The percentage unserved among Chinese, Vietnamese and Korean speakers fall somewhere in between.

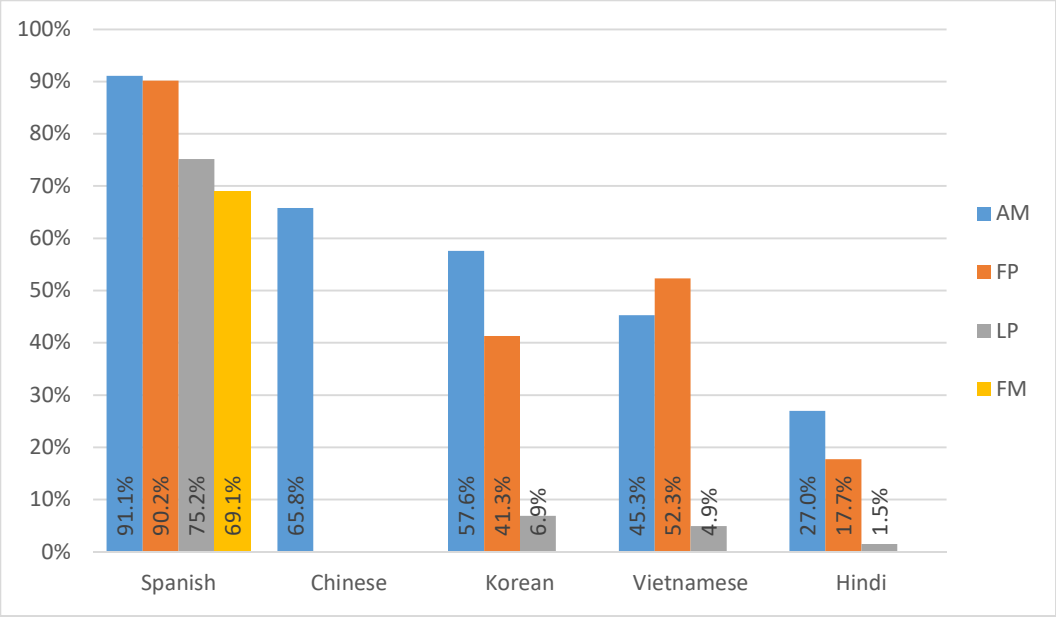


*Figure 3. Percentage of LEP individuals of given language who are served by an individual medium {Spanish – AM, FM, LPTV, FPTV; Korean, Vietnamese, Hindi – AM, FP, LP only; Chinese – AM only}*

## 4.2 Number of Broadcasts Received

In this section, we examine the number of broadcasts that LEP individuals can receive in their native language, regardless of whether these broadcasts come as AM radio, FM radio, LPTV of FPTV. The number of broadcasts that LEP individuals can receive varies tremendously, depending on both their language and their location. For example, while some LEP Spanish-speakers live in parts of the country reached by over two dozen different broadcasters with Spanish programming, there are also roughly 684 thousand LEP Spanish-speakers who cannot receive any broadcasts in Spanish. The number of broadcasts, ranging from 0 to 10, reaching LEP Spanish-speakers is shown in Figure 4. This is roughly 4.2% of LEP Spanish-speakers. If we excluded FM radio, as we do with the other languages, then 4.6% of LEP Spanish-speakers would be unserved instead of 4.2%.

Figure 5 and Figure 6 show a similar distribution, but for the less common languages of Vietnamese and Korean, respectively. In this case, we include AM, LPTV and FPTV broadcasters, but not FM. Because there are fewer Vietnamese broadcasters, the location with the most broadcasts in Vietnamese has just 6. 357 thousand LEP Vietnamese-speakers, or roughly 42%, are unserved by any broadcasters in their own language. This is more than half the number of unserved LEP Spanish-speakers, despite the fact that there are over 16 million LEP Spanish-speakers in the U.S. and just 850 thousand LEP Vietnamese speakers.

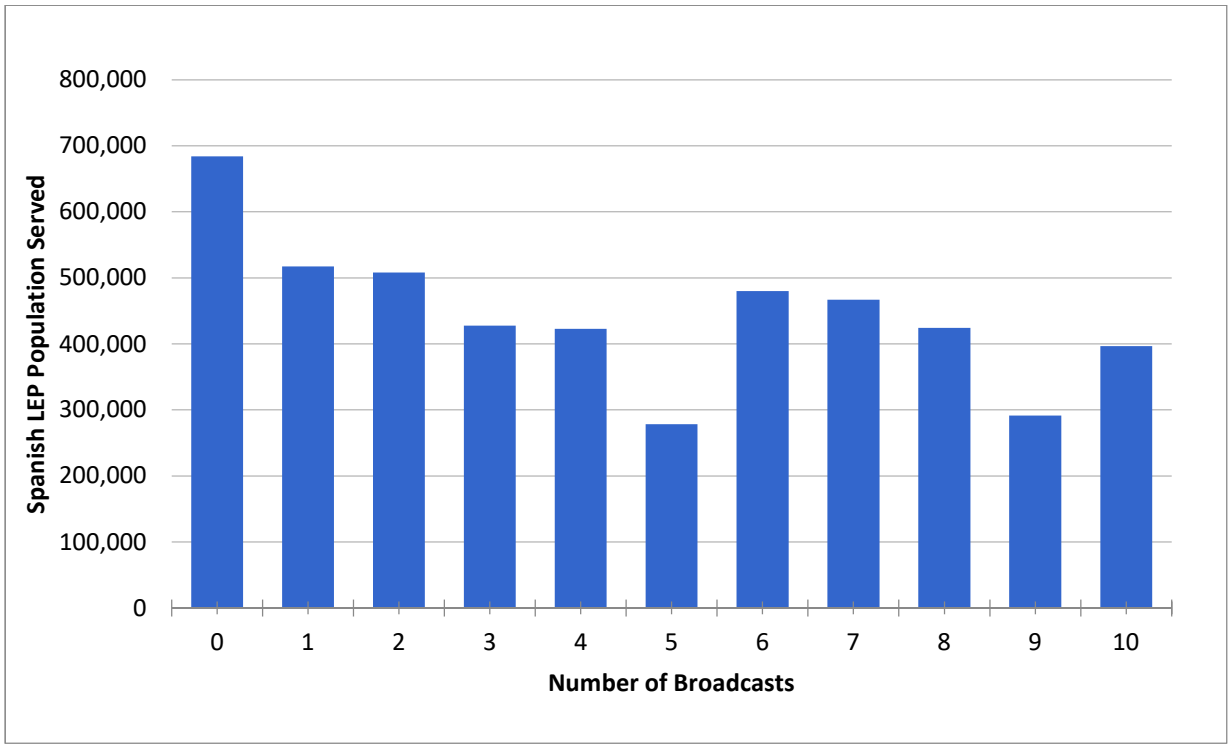


*Figure 4. Number of LEP Spanish-Speakers who can receive content in Spanish from k broadcasters for k between 0 and 10*

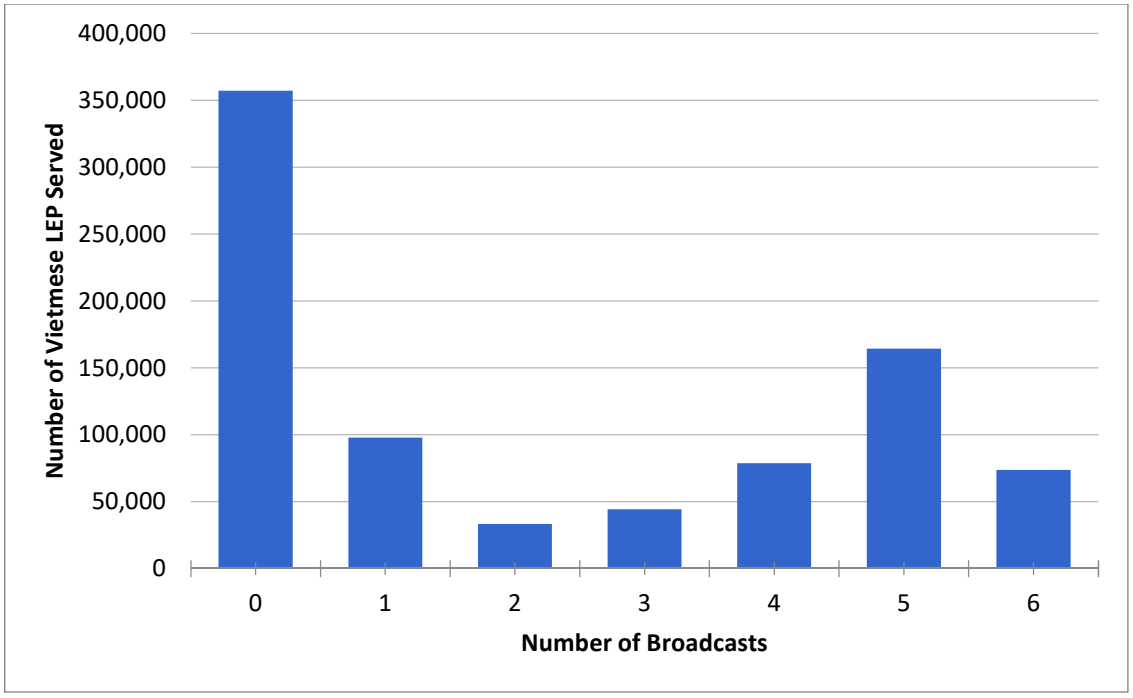


*Figure 5. Number of LEP Vietnamese-Speakers who can receive content in Vietnamese from k AM, FPTV or FPTV broadcasters*

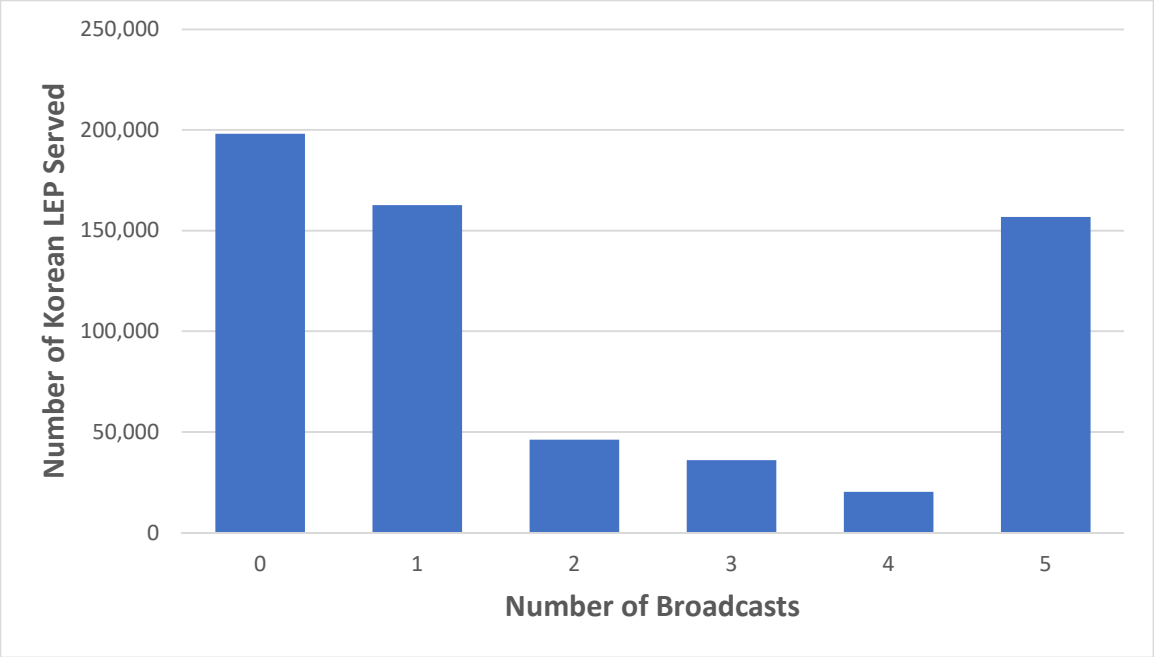


*Figure 6. Number of LEP Korean-Speakers who can receive content in Korean from k AM, FPTV or FPTV broadcasters*

### 4.3 Risk by Language

Figure 7 shows how the number of LEP individuals who can receive no AM, LPTV or FPTV broadcasts in their native language, and the number who can receive only one such broadcast, differs by languages. In the case of Spanish, we also show the number of LEP individuals receiving 0 or 1 broadcast from any media, including FM, and the addition of FM makes little difference.

This figure shows that the number of unserved and poorly-served individuals is largest among Spanish speakers, although not by as much as might be expected. This is because when there are more speakers of a given language, we can also expect more broadcasters in that language, and therefore a smaller percentage of unserved, as is shown in Figure 8. This shows that we need to consider methods of reaching unserved LEP individuals in a number of languages, and not just the most widely spoken.

These figures also show that for these four languages the number of LEP individuals that are served by only one broadcaster in their own language is smaller than but comparable to the number of individuals who are served by no broadcasters. While having one broadcaster is clearly better than none, these individuals may also be at risk because the lone broadcaster serving them may fail in a disaster, as occurred to Spanish-speakers during Hurricane Katrina [MMTC14].

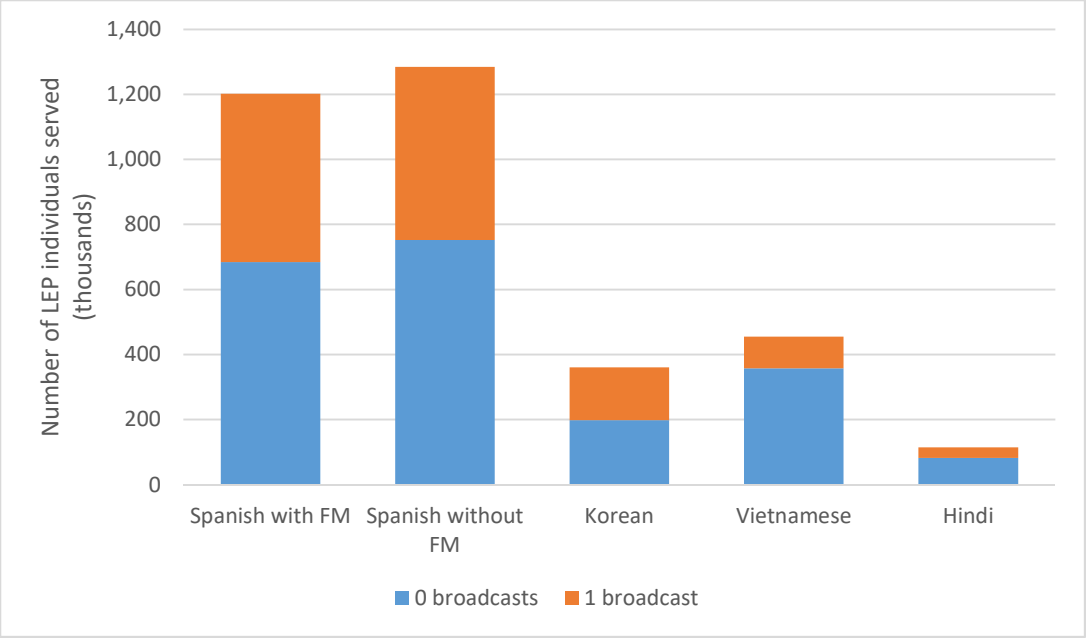


*Figure 7. Number of LEP individuals of given language (in thousands) that can receive the signal of 0 or 1 broadcaster in their own language.*

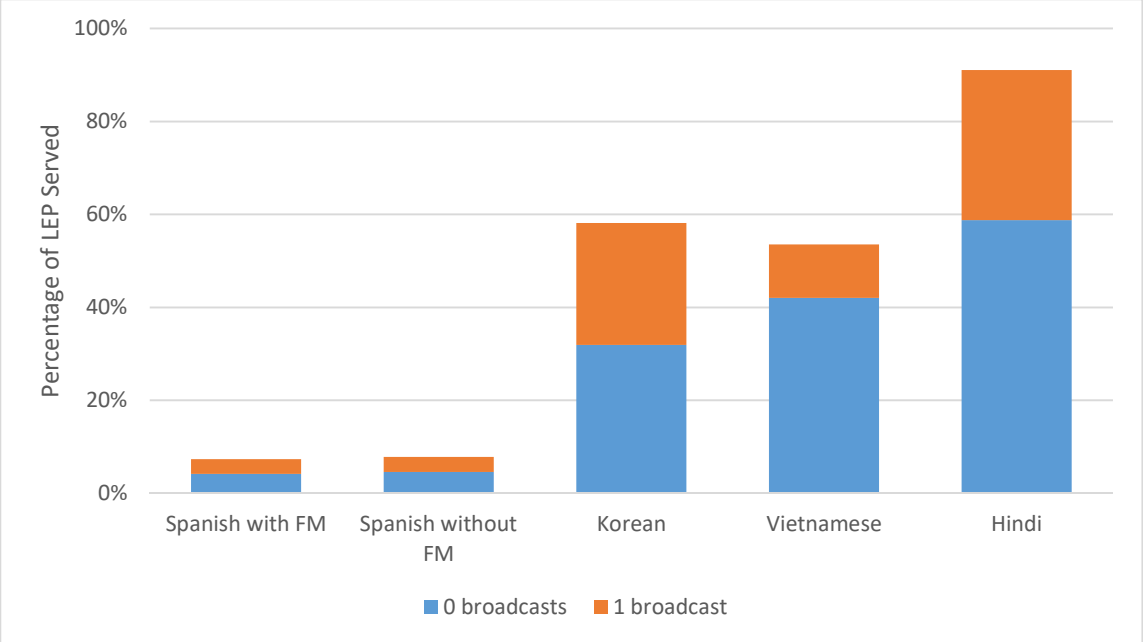


*Figure 8. Percentage of LEP individuals of given language that can receive the signal of 0 or 1 broadcaster in their own language.*

Although broadcasters of all types are helpful, some media are more important than others. The FCC has concluded that "AM radio has distinct advantages over other media during times of disaster and emergency, including the wide area coverage of some stations" [FCC15]. Nearly every car has an AM radio, and most homes include one or more AM radios. Perhaps most importantly, most AM radios have batteries so they will work even in the power outages that often accompany a large disaster, whereas most televisions require electricity. For these reasons, Figure 9 shows the number of LEP individuals from each of five language groups who are served by no or one broadcaster in their native language, respectively. There are roughly 2.9 million LEP individuals who speak these five languages that are unserved by any AM radio station, about half of whom speak Spanish. Another 1.7 million LEP individuals who speak these five languages are served by exactly one AM station.

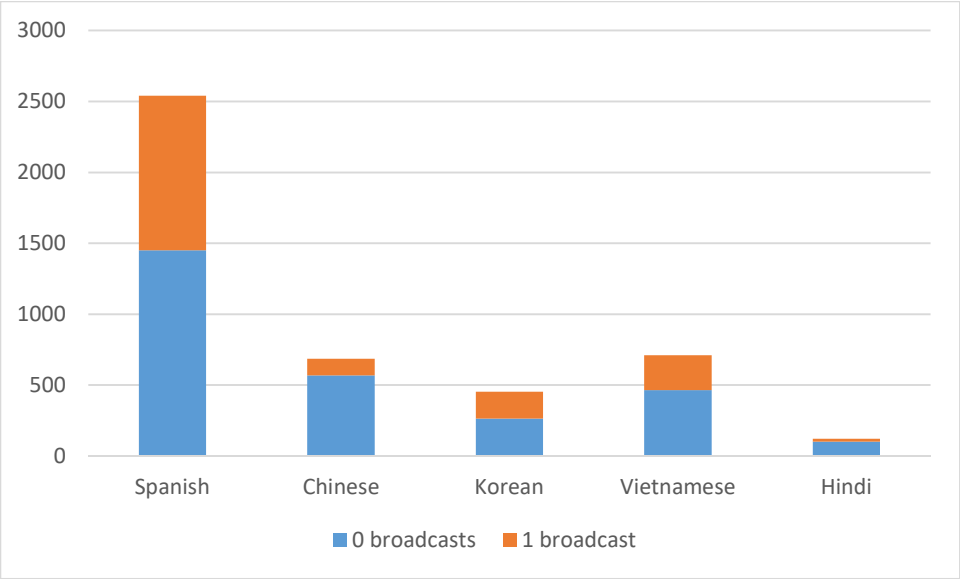


*Figure 9. Number of LEP individuals of given language (in thousands) that can receive the signal of 0 or 1 AM radio station in their own language.*

## 4.4 Geographic Distribution of Unserved LEP Populations

Figure 10 shows counties that have varying concentrations of Spanish-speaking LEP individuals with no broadcast coverage of AM or FM radio nor of LPTV or FPTV. Notably, regions where the concentrations of LEP individuals are particularly high, including counties at the Southern border of the United States, in southern Florida, and in the coastal Mid-Atlantic states, tend to be reasonably well-covered by broadcasts – with the notable exception of several counties in Texas. Areas with larger LEP populations that are not covered (defined as comprising over 5% of a county's population, and indicated in blue) lie just outside those regions: in the northern regions of the Southwest (Nevada, Utah Colorado, and Oklahoma), and in the south just north of Florida (Florida panhandle, Alabama, Georgia, Mississippi and Louisiana). A significant Spanish-speaking LEP population exists outside of those regions – spread across the Midwest and Northern states; however, these populations are generally less concentrated with between 1% and 3% of a county's population (red) or fewer (gray).

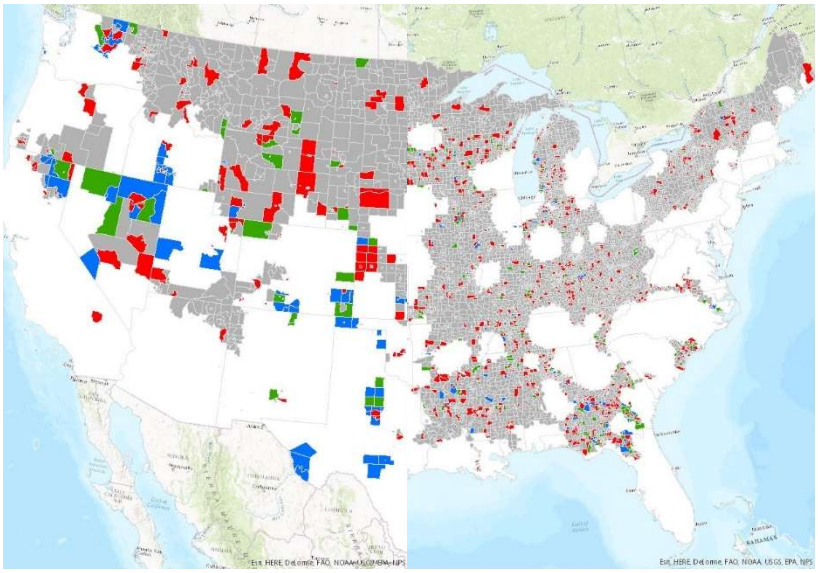

*Figure 10. Counties with over 5% (blue), 3% (green), 1% (red) and any (gray) Spanish-speaking LEP individuals in the population who receive no access to Spanish broadcasts (AM, FM, FPTV, LPTV)*

Figure 11 shows counties that have varying concentrations of Korean-speaking LEP individual with no broadcast coverage of AM radio, LPTV or FPTV. In contrast to the Spanish-speaking LEP individuals, regions where there is reduced coverage comes closer to the main Korean population centers. While visual inspection of the map suggests some areas of poor coverage in eastern California and the Southwest, there are higher concentrations of uncovered Korean-speaking LEP individuals in geographically smaller counties throughout the US – notably in Alabama, Georgia, Pennsylvania, and New Jersey.

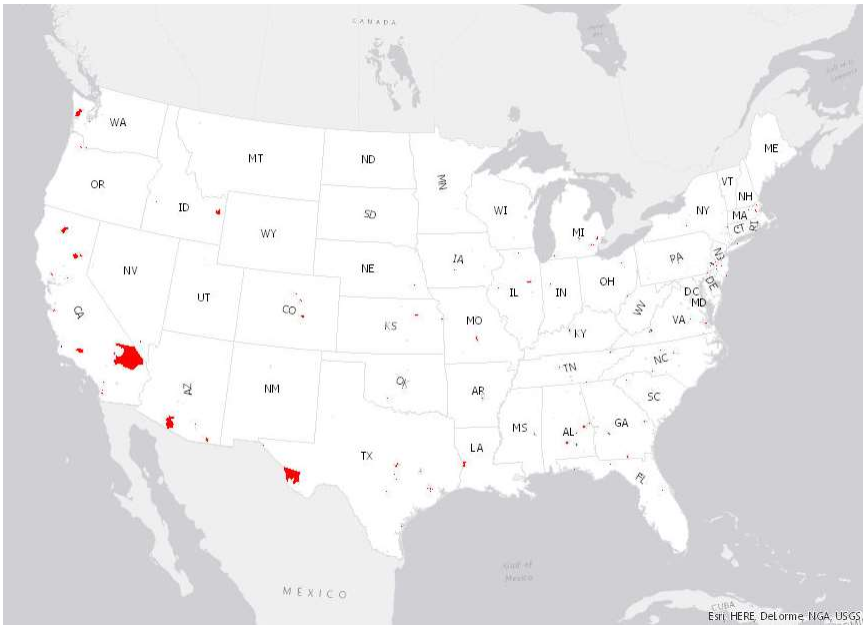


*Figure 11. Counties with over 5% (blue), 3% (green), 1% (red) and any (gray) Korean-speaking LEP individuals in the population who receive no access to Korean broadcasts (AM, LPTV, FPTV)*

Vietnamese-speaking LEP individuals seem similarly spread across the United States, will smaller pockets of concentrated, unserved individuals, shown in Figure 12. As with Korean, there appear to be several more pockets of Vietnamese-speakers in the South – Mississippi, Alabama, Georgia, and central Florida.

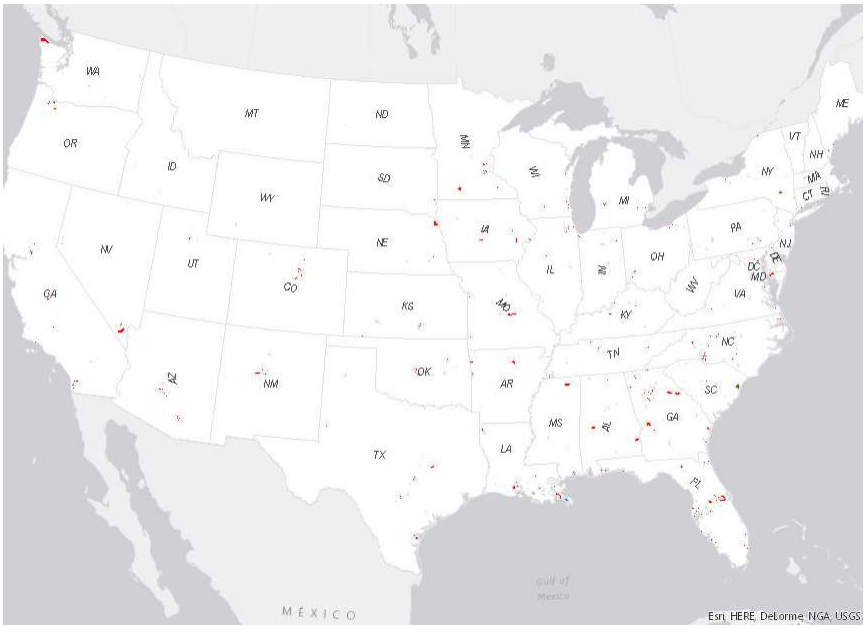


*Figure 12. Counties with over 5% (blue), 3% (green), 1% (red) and any (gray) Vietnamese-speaking LEP individuals in the population who receive no access to Vietnamese broadcasts (AM, LPTV, FPTV)*

Regions of concentrated, uncovered Hindi-speaking LEP individuals are generally fewer, perhaps owing to the smaller population overall, indicated in Figure 13. There is a notably large concentration of Hindi-speaking LEP individuals in Iowa, as well as less concentrated populations in Georgia.

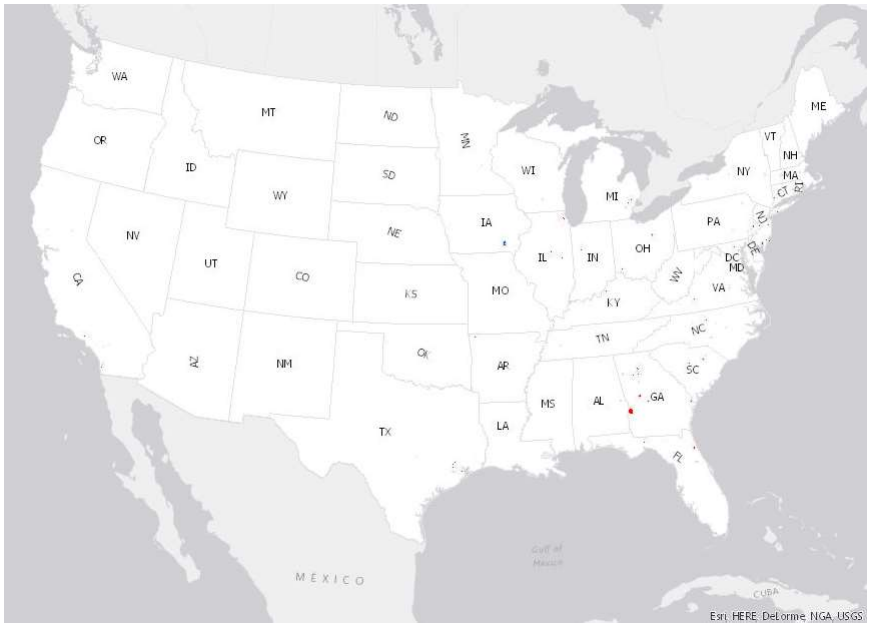


*Figure 13. Counties with over 5% (blue), 3% (green), 1% (red) and any (gray) Hindi-speaking LEP individuals in the population who receive no access to Hindi broadcasts (AM, LPTV, FPTV)*

The size and concentration of unserved LEP populations is presented in Figure 14, below. As with the above analysis, this includes all LEP individuals in a census tract that are not covered, even in part, by an AM, LPTV or FPTV broadcast for Vietnamese, Korean, and Hindi; or by an AM, FM, LPTV, or FPTV broadcast for Spanish – with differences from the earlier analyses due to differences in the apportioning methodology.

The unserved, Spanish-speaking LEP population is located in less concentrated areas compared to the total Spanish-speaking LEP population. For example, 16% of the unserved, Spanish-speaking LEP population (96 thousand individuals) live in tracts with 1% or fewer Spanish-speaking LEP individuals. In contrast, 2% of the total Spanish-speaking LEP population live in tracts with 1% or fewer Spanish-speaking LEP individuals. Nonetheless, many unserved, Spanish-speaking LEP populations still live in highly concentrated areas, with 43% of the populations (254 thousand individuals) living in areas where over 5% of the population are Spanish-speaking LEP individuals. This finding that unserved Spanish-speaking populations are more likely to live in less concentrated areas than the total Spanish-speaking population is likely linked to greater likelihood of finding broadcasters in areas where the LEP populations are concentrated, as previously discussed.

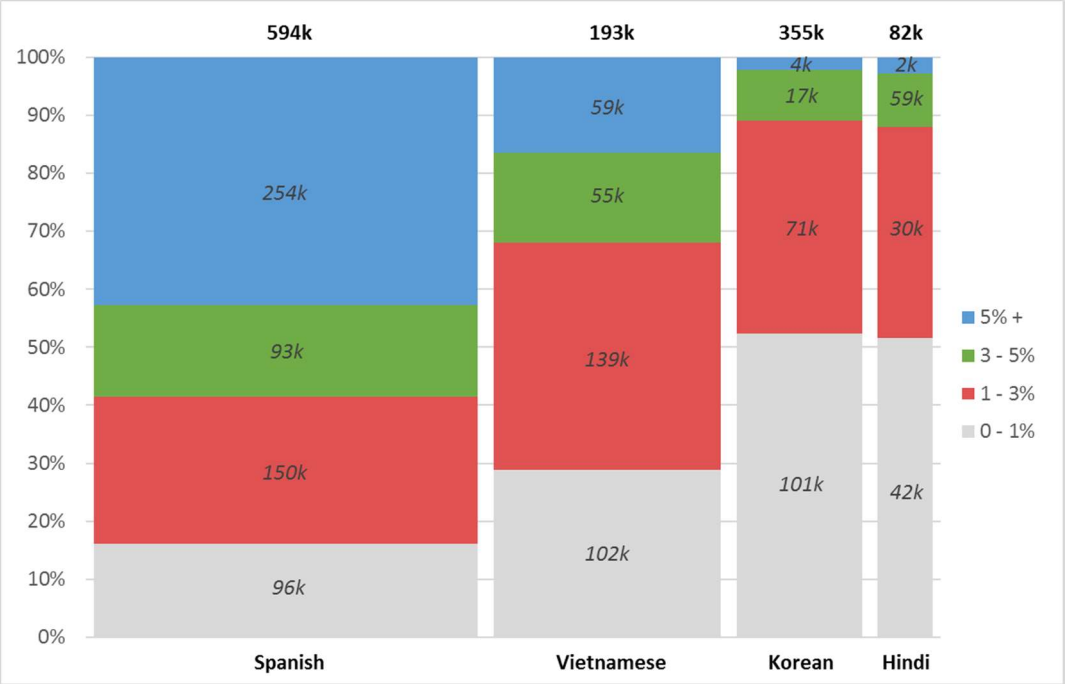


*Figure 14. Size and Concentration of Unserved LEP Populations. Areas indicate population sizes, bar heights represent proportion of the LEP subpopulation living in census tracts with concentrations of 5%+ (blue), 3-5% (green), 1-3% (red), and 0-1% (gray)*

The finding that unserved individuals are found in less concentrated areas also exists with the unserved Vietnamese-, Korean-, and Hindi-speaking populations. However, differences between the unserved and served populations for these languages are less dramatic than that in Spanish. Given the smaller total population, LEP individuals that speak these languages are already geographically dispersed and the number and reach of broadcasters already more limited. Thus, a larger portion of LEP individuals that speak Vietnamese, Korean, and Hindi are already dispersed and unserved.

In aggregate, roughly 26% of the unserved LEP populations (319k) that speak the languages considered live in census tracts where 5% or more of the population are also LEP individuals that speak their language. These populations might be more easily served through broadcast solutions; contingent upon the resources or infrastructure being in place. Roughly 60% of the unserved LEP populations live in census tracts where 3% or fewer LEP individuals speak their language. These populations may be more challenging to reach through a local broadcast and represent about 246k Spanish-speaking individuals, 241k Vietnamese-speaking individuals, 172k Korean-speaking individuals, and 72k Hindi-speaking individuals. Alternate methods of contact these individuals may be needed.

## 4.5 Significance of LPTV

There is particular uncertainty about the future of LPTV, as discussed in Section 1.When making decisions about LPTV, one thing policymakers and community leaders should consider is the impact on LEP communities if LPTV stations are lost. To that end, for each of four languages, Figure 15 shows the number of LEP individuals who are served in their own language by one or more LPTV

broadcasters, but who are not served by AM or FPTV. This is an approximation of the number of individuals who would no longer be able to receive content in their own language if LPTV stations ceased to operate. The total number for these four languages alone is roughly 100 thousand. For this analysis, we use the simplifying assumptions that were discussed in Section 4.5.

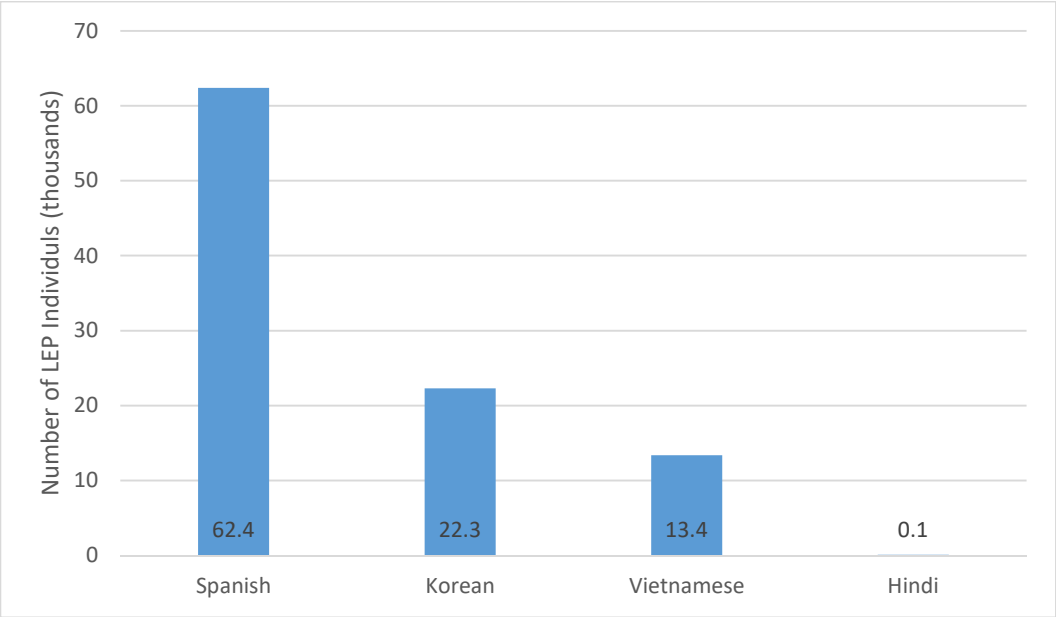


*Figure 15. The number of LEP individuals who speak Spanish, Korean, Vietnamese, and Hindi who can receive LPTV broadcasts in their native language, but not AM or FPTV broadcasts.*

# 5 Conclusions

There are roughly 25 million LEP individuals in the U.S., and that population is growing faster than the general population [CENS14]. We find that LEP individuals are more than twice as likely as the general population to live in counties with high disaster risk, which makes it even more important to provide emergency information in a language they understand.

We find that a substantial majority of LEP individuals are served by at least one broadcaster in their native language, but the number who are unserved is still large. Roughly 1.4 million LEP speakers of Spanish, Korean, Vietnamese and Hindi cannot receive AM, FPTV or LPTV broadcasts in their language. If we could include the hundreds of other languages spoken in the U.S., including Chinese (which is spoken by 1.6 million LEP individuals), we would expect to find that the total number of LEP individuals who are completely unserved by broadcasters today is *over two million*. In a disaster, these individuals' lives could depend on funding information sources other than TV and radio broadcasters. At least for the four languages we analyzed in depth, the number of individuals served by only a single broadcaster is not far behind. These individuals could be vulnerable if that one broadcaster is damaged in a disaster, goes out of business, or simply chooses not to broadcast emergency information in the needed language during the disaster.

Both AM radio and full-power television (FPTV) were quite important for information dissemination in languages other than English. While low-power television (LPTV) reached fewer LEP individuals than the other two, it is still significant. For example, close to 100 thousand LEP speakers of Spanish, Korean and Vietnamese were served in their own language by LPTV but not FPTV or AM. Speakers of other languages, especially Chinese, are presumably similarly situated. Thus, if LPTV broadcasters should disappear after the FCC's upcoming spectrum incentive auction [FCC12], this will have an effect on LEP communities.

Of the four languages we analyzed, the largest group of unserved LEP individuals were Spanish speakers. However, considering that more than two thirds of LEP individuals in the U.S. are Spanish-speakers, these differences were smaller than one might expect. This is because languages that are spoken more widely also tend to have more broadcasters. While providing resources in Spanish is important, this shows that policymakers need to consider other languages as well, including Chinese, Korean and Vietnamese.

For similar reasons, the unserved LEP individuals are not necessarily in locations that policymakers might expect. For example, disseminating emergency information might be problematic in census tracts where more than 5% of the population are Spanish-speakers who are not served in Spanish by any broadcasters. Nevada and Georgia have a number of tracts like this, but there are none in southern California or southern Florida, as they are already served by Spanish-language broadcasters.

Policies regarding emergency planning should reflect these results regarding the language and locations of the unserved LEP population. For example, some have proposed new regulations that would require more broadcasters to provide information in languages other than English in TV and

radio markets where a particular language is spoken by more than 5% of the population. Although there are exceptions, TV and radio coverage areas tend to be larger than census tracts, so the number of coverage areas in which more than 5% of the population speak a language other than English is much smaller than the number of census tracts. While there is value to making sure that LEP individuals are adequately served in those broadcast markets where languages other than English are widely spoken, such a policy alone will not help those unserved LEP individuals who do not live within large concentrations of individuals who speak the same language.

While broadcasting remains critical for the dissemination of emergency information, we can also address these problems through more effective use of new and emerging technology. For example, nearly two thirds of adults in the U.S. own smart phones [PEW15]. It is possible to design smart phone applications that know their current location, that knows the preferred language of their user, and that can automatically retrieve information from a variety of sources. However, challenges remain to make devices and applications like this available, and to encourage their use. Technical advances could also help [JAYA16], such as improvements in real-time language translation with easy-to-use interfaces.

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# 7 References


[BETT15] R. Bettencourt and J. M. Peha, "On the Trade-off between Spectrum Efficiency and Transmission Cost in Traditional and SFN-Based Broadcast Television," *IEEE Conference on Dynamic Spectrum Access Networks (DySPAN)*, 2015. www.ece.cmu.edu/~peha/papers.html

[BIA14a] BIA/Kelsey, *Investing in Radio Market Report*, 2014.

[BIA14b] BIA/Kelsey, *Investing in Television Market Report*, 2014.

[CENS14] U.S. Census, 2010-2014 American Community Survey, https://www.census.gov/programs-surveys/acs

[FCC12] Federal Communications Commission, Notice of Proposed Rulemaking in the matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Docket No. 12-268, Oct. 2, 2012. http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-12-118A1.pdf

[FCC14a] Federal Communications Commission, FM Service Contour Data Points, November 2014. https://www.fcc.gov/media/radio/fm-service-contour-data-points

[FCC14b] Federal Communications Commission, TV Service Contour Data Points, November 2014. https://www.fcc.gov/media/television/tv-service-contour-data-points

[FCC15] Federal Communications Commission, First Report and Order, Further Notice of Proposed Rulemaking and Notice of Inquiry, in the Matter of Revitalization of the AM Radio Service, FCC 15-142, Oct. 23, 2015. https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-142A1.pdf

[FCC16a] Federal Communications Commission, Order in the Matter of Review of the Emergency Alert System, EB Docket No. 04-296, March 30, 2016. https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-32A1.pdf

[FCC16b] Federal Communications Commission, AM Query Broadcast Station Search, May 2016. https://www.fcc.gov/media/radio/am-query

[FEMA14] U.S. Federal Emergency Management Agency, "Disaster Declarations By Year | FEMA.Gov," https://www.fema.gov/disasters/grid/year

[HVRI14] Hazards & Vulnerability Institute, Spatial Hazard Events and Losses Data for the United States, November 2014. http://hvri.geog.sc.edu/SHELDUS/

[JAYA16] K. Jayakar, C. Maitland, J. M. Peha, S. Strover, J. Bauer, "Broadband 2021: Report to the U.S. Broadband Opportunities Council on the Development of a National Broadband Research Agenda, 2016. http://www..ece.cmu.edu/~peha/papers.html

[MMTC14] "Comments of the Minority Media and Telecommunications Council," in the Matter of Review of the Emergency Alert System, EB Docket No. 04-296, May 28, 2014. http://ecfsapi.fcc.gov/file/7521153393.pdf

[PEW15] Pew Research Center, "U.S. Smartphone Use in 2015," April 1, 2015. http://www.pewinternet.org/files/2015/03/PI_Smartphones_0401151.pdf

[RABB14] RabbitEars, RabbitEars.info, 2014. http://www.rabbitears.info

[SNL14] SNL Kagan, *Media and Communications*, 2014