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Bridging the gap: a review of the factors contributing to differences in vaccination coverage among rural and urban adults

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Abstract

Purpose: To examine factors contributing to vaccination coverage differences between rural and urban adult populations; evaluate intervention studies aimed at increasing vaccine uptake among rural adult populations.

Methods: We reviewed literature published between January 2000 and April 2024. Findings are presented using the Capability, Opportunity, and Motivation Model for Behavior Change. Intervention studies were systematically evaluated using Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.

Findings: Forty-five studies were included in the final analysis and summarized qualitatively within the following topic areas: 1) factors contributing to vaccination coverage differences between rural and urban adult populations and 2) effective strategies for increasing vaccine availability among rural adult populations. Of the six intervention studies identified, only three met the criteria for direct evidence (Level I or II, fair or good quality).

Conclusions: Vaccination coverage differences between rural and urban adults stem primarily from opportunity and motivation-related factors. Limited intervention studies have not effectively addressed the individual or systemic barriers to vaccination for rural populations.

Keywords

Immunization; Adult; Rural; Urban; Coverage

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CRediT authorship contribution statement

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

1. Introduction

Interest in rural population health research has notably increased in recent years; however, many challenges encountered by rural communities are longstanding [1]. While disease surveillance in rural populations is often incomplete and fragmented, recent availability of more comprehensive data has demonstrated the complexity of factors contributing to differences in health outcomes between rural and urban populations [2]. The interaction between population density, healthcare infrastructure, and other drivers of health, and how these factors affect vaccine-preventable disease outcomes among rural populations is unclear [3].

Unlike with pediatric vaccination, no national immunization surveillance system exists for adults; however, observed low vaccine coverage rates among rural adults are consistent with those reported in rural pediatric populations [4]. Rural adults have lower uptake than urban adults for many vaccines; for example, rural adults during the 2023–2024 flu season demonstrated lower flu vaccine uptake compared to their urban counterparts (42 % vs 49 %) [5]. This difference is even more pronounced for COVID-19 vaccinations, where differences in coverage between urban and rural areas more than doubled (from 7 to 16 percentage points) from 2021 to 2022 [6].

Continued under-vaccination among rural populations further increases risk for vaccine-preventable disease and outbreaks in these communities. Therefore, the purpose of this literature review is to examine factors contributing to vaccination coverage differences between rural and urban adult populations. The Capability, Opportunity, and Motivation Model for Behavior Change (COM-B) [7] is used as guiding framework to highlight key factors contributing to vaccination coverage differences between rural and urban adult populations. Additionally, we systematically evaluated intervention studies to identify effective strategies for increasing vaccine availability among rural adult populations.

2. Methods

2.1. Search strategy

We used modified Cochrane Review strategies to search ten databases (Medline, Embase, CAB Abstracts, Global Health, PsychInfo, Cochran Library, Scopus, Academic Search Complete, CINAHL, and ProQuest Central) [8–12]. The full search strings for each database are available in Appendix Table 1. Non-English language studies were excluded, and the publication date was restricted to January 2000 to April 2024. The search was conducted in April 2024 and returned 3416 abstracts; all articles were downloaded into EndNote X9.3.3 (Philadelphia, PA).

Four authors (C.J.G., A.F.A., X.R., and J.Z.) conducted a preliminary review of abstracts with at least two authors assessing each full article for relevance. Articles were eligible for inclusion if they met both of the following: 1) vaccine coverage data for rural or both rural and urban adult populations were reported and 2) individual, interpersonal, organizational, or society-level factors contributing to coverage differences was assessed. To the authors

knowledge, this is the first review of its kind that addresses rural adult immunization. Therefore, we did not apply a pre-established definition of rurality; instead, we utilized the definitions provided in each individual study. Consensus was required for inclusion and disagreements were settled by a third reviewer (M.C.L. or J.M.N.). References for included articles were manually checked to identify relevant studies not captured in the initial search.

Of the 3416 abstracts returned by our search, eight duplicative references were removed. An additional 3174 were excluded after preliminary review for the following reasons: abstract unavailable; duplicate abstract; epidemiological study (e.g., studies estimating prevalence, morbidity, and mortality); unlicensed (e.g., HIV) or nonroutine (e.g., anthrax or cholera) vaccines; methodological study; no within-study comparison of urban and rural populations or data not stratified by rurality; not a study of differences in vaccine receipt; adults were not the subject of the study or separate data on adults was not available; study not based in the United States; and study did not report original data. Many excluded abstracts fell into multiple exclusion categories (Fig. 1).

The full texts of 235 abstracts were obtained and assessed for eligibility. Following the review, 190 additional studies were excluded: 44 were not stratified by rurality, 34 did not assess reasons associated with observed differences, and 112 were excluded for reasons noted above. One additional study was identified during the manual bibliography review. A standardized template was used for extracting the included articles.

2.2. Adult vaccination schedule

As of the time the review was conducted, the Advisory Committee on Immunization Practices (ACIP) recommended the following vaccinations to adults ages 19 years or older [13]: COVID-19; influenza; respiratory syncytial virus (RSV); tetanus, diphtheria, pertussis (Tdap); pneumococcal; serogroup A,C, W, Y meningococcal, serogroup B meningococcal; Haemophilus influenza type b; inactivated polio; measles, mumps rubella (MMR); varicella; human papillomavirus (HPV); Mpox; hepatitis A; hepatitis B, and Zoster vaccines. Individual recommendations may vary based on health status, age, and the presence of additional risk factors. Additionally, although not routinely recommended, Tdap, MMR, HPV, varicella vaccines may be indicated for certain adults if no record of childhood vaccination is available.

2.3. Conceptual framework

This review is grounded in the COM-B model for behavior change which outlines three essential conditions for voluntary behavior: capability, opportunity, and motivation [7]. *Capability* pertains to an individual's ability to take action. *Opportunity* involves external factors that facilitate action. *Motivation* encompasses both conscious decision-making and emotional responses. Both *Capability* and *Opportunity* conditions are further defined by either psychological or physical abilities associated with an action; *Motivation* can be described as reflective intentions or automatic impulses. Findings are organized and summarized by COM-B model condition and sub-level.

2.4. Narrative summary of non-intervention studies

Two coauthors (C.J.G. and A.F.A.) independently reviewed each non-intervention study and extracted author name(s), title, publication year, funding source, methods, study population demographics, rurality definition, data metrics and analysis approach, and results.

2.5. Systematic review of intervention studies

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to review studies on interventions to increase vaccine uptake in rural adult populations [14]. Included studies assessed immunization of adult populations 18 years of age or older using either single-level or multilevel interventions for any ACIP-recommended adult vaccination [13], and reported vaccination uptake or changes in uptake over time by rurality.

Articles were not restricted by study type (e.g., randomized controlled trial, cohort, longitudinal), intervention type, population evaluated, or whether a priori intention to reduce rural and urban differences in adult vaccination coverage was evaluated. We used the following PICOT question components to assess and compare included intervention studies: *Population (P)* rural and urban adult populations in the U.S. eligible for vaccination; *Intervention (I)* Providers, systems, or patient-specific intervention; *Comparison (C)* No intervention; *Outcome (O)* Difference in vaccination coverage or vaccine uptake by rurality; *Time (T)* Before and after intervention.

Two coauthors (C.J.G. and A.F.A.) independently reviewed each intervention study and extracted the author(s), year of publication, funding source, study design and setting, timing, study population, vaccine(s) of interest, intervention(s), comparison groups, outcomes, results, strengths and weaknesses of the study, and level of evidence (Table 2). To assess the risk of bias, each study was independently evaluated based on the U.S. Preventive Services Task Force hierarchy of research design [15]. This hierarchy includes Level I (randomized controlled trials), Level II (controlled trials without randomization, cohort studies, or case-control studies), and Level III (opinions or case reports). Additionally, studies were graded for internal validity using the following criteria: initial assembly of comparable groups; maintenance of comparable groups; measurement; intervention definition; outcomes; analysis [15]. Validity scores were defined as “good” (meets all criteria), “fair” (does not meet all criteria), or “poor” (contains a fatal flaw). Quality factors such as research design and methodological features, including the use of comparable groups, measurements, potential confounders, analytical approach, and outcome ascertainment, were assessed. Due to the variability in study designs and reporting of outcomes, we did not conduct a quantitative analysis or compute summary outcome measures.

3. Results

A total of 45 studies reported original data, were conducted within the United States, met the objectives outlined in this review and subsequently included in the final analysis. Thirty-nine (86.7 %) studies assessed factors contributing to differences in vaccination coverage between rural and urban adult populations. Six (13.3 %) studies examined interventions

to address vaccination coverage differences and increase vaccine uptake in rural adult populations.

3.1. COM-B level by vaccine type

Nineteen (42.2 %) of the 45 included studies assessed COVID-19 vaccination in rural and urban, or rural-only adult populations; most (16 of 19; 84.2 %) studies focused on either *Opportunity* or *Motivation-level* factors (Table 1). The second most commonly evaluated adult vaccine was influenza (14 of 45, 31.1 %), with six studies (6 of 14, 42.9 %) assessing physical opportunities to vaccination. The *Capability* level had the fewest number of studies across all vaccines for which publications were available (9 of 45, 20.0 %).

3.2. Capability (psychological and physical)

We identified six studies addressing psychological capability for vaccination among rural adults [16–21]. One study of rural school employees found high MMR vaccine knowledge, acceptance, and perceived effectiveness [16]. In contrast, knowledge of HPV disease or vaccine was highly variable among the general population, with rural adults demonstrating lower knowledge as compared to their urban counterparts [17]. For physical capability, transportation challenges such as long travel distances were a predominant barrier to vaccine access among rural but not urban adults and resulted in lower COVID-19 [18,19] and HPV [20] vaccination coverage. However, a study assessing barriers to flu vaccination during a natural disaster observed veterans living in rural areas had higher vaccine coverage as compared to urban areas [21].

3.3. Opportunity (physical and social)

Two studies identified cost as a substantial barrier to adult vaccination uptake within rural areas [18,22]. Health insurance status influenced access to vaccinations regardless of rurality, with insured individuals showing significantly higher vaccination coverage [23–27]. Among the uninsured, pregnant women in rural areas were less likely to receive flu or Tdap vaccinations compared to their urban counterparts [23,24]. However, pregnant women in rural areas with public insurance exhibited higher vaccination coverage for both flu and Tdap vaccines compared to publicly insured women living in urban areas [24].

Nine studies identified access to healthcare providers was directly linked to vaccination coverage regardless of rurality [23,25,28–34]. In comparison to urban adults, low numbers of physicians per capita correlated with decreased COVID-19 vaccination coverage among rural adults [25,28]. Among rural physicians, obstetricians were less likely than family physicians to report available flu vaccines and often lacked appropriate vaccine storage units [32]. Rural adults were less likely to report receipt of provider recommendation for vaccination as compared to their urban counterparts [22,31,33]. Within rural Latino communities, language barriers and inadequate cultural competency of healthcare professionals (HCPs) further complicated access to COVID-19 vaccinations [34].

Five studies identified community acceptance as a crucial factor in shaping vaccination behaviors in rural populations, specifically by poverty status [35,36] and health professional

shortage area [37–39]. Within rural communities, individuals hesitant to get the COVID-19 vaccine often felt that medical professionals and important people in their lives disapproved of them receiving the vaccine [35]. Similarly, younger rural women were more likely to receive the HPV vaccine if they believed that someone in their family supported their decision [36,38]. Additionally, “Spheres of Silence” surrounding HPV vaccination were observed within rural Appalachian communities for both provider and community contexts; discussions regarding HPV vaccination were further complicated by maternal [39] but not paternal [38] influence. Community health resources, such as the number of non-religious and nonprofit organizations per 1000 residents were associated with increased COVID-19 vaccination intention among rural adults; conflicting findings were observed for adults residing in urban areas and dependent on metropolitan statistical area distinctions [27].

3.4. Motivation (reflective and automatic)

Eight studies among rural populations found mistrust of the government and deeply held religious beliefs were significant reasons cited by patients in rural communities for declining COVID-19 vaccination [18,34,40–44] and HPV vaccination [45]. For HPV vaccine, lack of trust was compounded by a “Protection Dilemma”, where skepticism toward vaccine advertising and negative perceptions of pharmaceutical companies contributed to low adult vaccine uptake within rural Appalachian communities [39]. Effective messaging strategies tailored to specific religious beliefs or that prioritized open conversations while avoiding fear-based language was found to be essential when addressing these concerns among adults living in health professional shortage areas [46].

Four studies found intent to vaccinate was highly correlated with the perceived benefit of vaccination regardless of rurality [20,47–49]. Within rural communities, lack of intent to complete HPV vaccination was associated with the increased likelihood of not finishing the full vaccine series [20]. Intent to receive flu vaccination was moderately correlated with the belief that vaccination is effective, but no correlations were found with the belief that vaccines are not effective [48]. Within rural communities, low perceived risk of infection or severe disease corresponded with reduced intent to receive COVID-19 [18] and HPV vaccination [39].

One study found as population density decreases, behaviors promoting others’ well-being increased due to a greater perceived impact, including for COVID-19 and flu vaccination [50]. However, although the perceived disease risk for COVID-19 was generally higher in rural areas compared to suburban and urban residential types, COVID-19 vaccination coverage for migrant adults remained low [51]. The perception of vaccination as a personal choice, most notably within low-income rural communities [35,45], heavily influenced individual willingness to receive adult vaccination, particularly for COVID-19 vaccination [35]. Engagement strategies within health professional shortage areas that emphasized how messages were delivered and included options significantly impacted perception by ensuring individuals felt a sense of control over their personal health decisions [46]. Concerns about perceived behavioral control were not observed within health professional shortage areas for routine adult vaccines such as Tdap, Varicella, HPV, Hepatitis A/B, and meningococcal vaccines [37].

Five studies found that fear played a significant role in shaping community attitudes toward vaccination; vaccine-hesitant individuals within rural communities often expressed heightened concerns regarding vaccine side effects associated with COVID-19 and flu vaccination [53]. Within migrant [52] and rural [54] communities, conspiracy theories also significantly influenced adult vaccine uptake including the belief that COVID-19 vaccines caused harm or were part of broader population control efforts [44,52]. Additionally, a “Threat-type Dilemma” arose concerning HPV vaccination, where rural Appalachian parents grappled with fears surrounding vaccine side effects alongside the risk of their daughters developing cervical cancer [39]. General perceptions that vaccines were painful further contributed to low adult vaccine uptake within rural communities and health professional shortage areas [30,47].

3.5. Interventions

This review identified six intervention studies that addressed our PICOT question (Table 2) [50–60]. Three studies met the inclusion criteria for direct evidence (Level I or II, good or fair quality), and the remaining three studies met the inclusion criteria for indirect evidence (Level I or II or III, fair or poor quality). Included studies examined single or multilevel interventions aimed at increasing the availability of flu, pneumococcal, HPV, or COVID-19 vaccination among rural adult populations.

Three prospective studies provided direct evidence of interventions to increase vaccine uptake among rural adult populations [55–57]. The first good-quality study conducted was a randomized, controlled trial multi-site intervention grounded in the Theory of Planned Behavior. Of patients who received the intervention, 43.3 % completed the HPV vaccine series compared to 31.9 % of patients who received standard care ($p = 0.03$) [56]. The second good-quality study used a double-control, randomized trial design to test a social media intervention on a national sample. The findings of this study demonstrated Public Service Announcements (PSA) featuring testimonials from clinicians were more successful in increasing intentions to receive the primary COVID-19 vaccine series than two control PSAs ($p = 0.015$ and $p = 0.01$, respectively) [57]. The fair quality study used an unblinded pre-post-intervention design with a moderate sample size ($n = 657$) and found a significant increase in flu vaccination coverage for all patients 65 years and older presenting to the clinic post-intervention (28.0 % at baseline and 54.0 % post-intervention, $p < 0.05$) [55].

All three studies identified as poor quality implemented educational interventions [58–60]. A comprehensive multilevel intervention to increase vaccination among rural adults living in West Virginia demonstrated low income and low educational status were both significantly associated with low COVID-19 vaccine uptake ($p = 0.005$); the educational intervention increased willingness to receive vaccination by 11.4 % [59]. However, intervention effectiveness could not be determined because all participants received the intervention and no pre/post intervention design was used. Although similar results were observed for an intervention to increase HPV vaccine knowledge among adults ≥ 18 years and older ($p < 0.05$), the analyses were limited by poor study design and small sample size [60]. A non-randomized, experimental study among Medicare beneficiaries (aged ≥ 65 years) observed a 3.7 percentage point increase in pneumococcal vaccination claims following

receipt of educational campaign materials and mailed vaccine reminders; however, the lack of a non-intervention comparison group prevented assessment of the intervention's true effect [58].

The strengths of the studies providing direct evidence were multilevel interventions based on a health theory. Additionally, all three studies analyzed and reported results for all comparison groups; one fair-quality study measured vaccination coverage at baseline and post-intervention [55]. In contrast, the weaknesses of the indirect studies include the following: no or incomplete comparison groups, no adjustment for potential confounders, and a higher risk of potential bias (e.g., social desirability bias). Overall, identified studies evaluating interventions to increase vaccine uptake among rural adult populations were limited and did not adequately address individual or systemic barriers to vaccination.

3.6. Defining rurality

Sixteen (35.5 %) studies defined rurality using Rural-Urban Continuum Codes [16,17,20,23–25,27–29,41,48–50,54,58,60]. The remaining 29 studies used the following classification systems or definitions: Rural-Urban Commuting Area Codes (7 of 45; 15.5 %) [18,19,21,32,43,57]; health professional shortage areas (7 of 45; 15.5 %) [31,37,38,46,47,55,56]; migrant communities (3 of 45; 6.6 %) [40,51,52]; poverty status (2 of 45; 4.4 %) [35,36]; previous research in differences of vaccination coverage (2 of 45; 4.4 %) [39,45]; self-report (2 of 45; 4.4 %) [33,42]. Six (13.3 %) studies did not specify a definition of rurality [26,30,44,53,59].

4. Discussion

In this comprehensive review, we examined 45 studies investigating factors that contribute to differences in vaccination coverage between rural and urban adult populations. Many studies assessed opportunity and motivation-related factors associated with vaccination coverage differences between rural and urban adults. Among these studies, only six focused on interventions to increase vaccination coverage among rural adult populations. The limited number of published intervention studies underscores the general lack of research focused on protecting rural adult populations against vaccine-preventable diseases.

This review identified a significant imbalance in available research addressing low vaccine coverage among rural adults, with most studies concentrating predominantly on COVID-19, HPV, and flu vaccinations. For COVID-19, flu, and HPV vaccination, apprehension toward vaccination was often rooted in anecdotal experiences and cultural narratives [35,39,45,46]. Further, studies focused on COVID-19 and HPV vaccination often highlighted a pervasive mistrust of government entities and pharmaceutical companies, which significantly reduced the uptake of these vaccines among rural adults. Concerns regarding vaccine safety were consistently reported; fears about potential adverse effects and beliefs that vaccines may cause more harm than benefit were especially prominent for COVID-19 and HPV vaccines. Although this review included only a limited number of articles regarding uptake of adult-recommended vaccines among rural populations, similar findings were not observed for other vaccines.

Healthcare provider shortage areas in rural communities are well established [61], and inadequate health infrastructure greatly affects access to preventive health services [62]. Our review found that vaccine uptake among rural adult populations is often constrained due to limited vaccination opportunities with similar obstacles noted in the rural pediatric vaccination context [4]. Among clinicians that serve rural areas, some specialists including obstetricians lack the necessary equipment to stock and administer routine vaccinations, further contributing to missed opportunities for vaccination [32]. The use of non-traditional healthcare settings, such as pharmacies can support increased vaccine access among rural adults. Further research on the effects of non-traditional settings in reducing vaccination barriers for rural populations could offer valuable insights into how these alternative vaccine administration sites can enhance access to vaccines.

Our findings suggest that rural adults exhibit an increased complacency regarding vaccine-preventable diseases and decreased intent to receive vaccinations compared to their urban counterparts. Multiple studies in this review reported that rural patients often do not receive a recommendation to get vaccinated from their physician—a strong provider recommendation for vaccination substantially influences an individual’s decision to get vaccinated [63]. This review also found that rural adults are more inclined to seek approval from their physicians before receiving a vaccine, highlighting the importance of community acceptance in the decision-making process. Limited capacity or time constraints often result in healthcare providers’ prioritization of acute care over preventive care needs [64]. Further research can further our understanding of factors that affect the quality of preventive care offered by rural clinicians, particularly regarding vaccination recommendations and their effect on vaccine complacency.

Multilevel education-based interventions, including mailers [55], videos [56], provider scripts [59], or combined with vaccine provision, were the most effective in increasing vaccination intentions among rural adults. Similarly, the authors found that large-scale media campaigns featuring clinician testimonials improved vaccine uptake among rural adult populations [57]. However, while raising awareness about the risks of vaccine-preventable diseases is important, it is not enough on its own. To better support rural adult patients in making informed decisions about recommended vaccines, clinicians serving rural populations can prioritize patient engagement surrounding vaccination during clinical encounters, leverage additional opportunities for expanding patient education, and explore partnerships with non-traditional healthcare settings.

This review is subject to at least four limitations. First, the variability in how rurality is defined may reduce the generalizability of these findings. Second, this review excluded gray literature (e.g., reports, conference proceedings, industry papers, etc.). Third, only a limited number of intervention studies inclusive of rural adult populations were available. As a result, this synthesis of evidence concerning contributing factors to differences in adult vaccine coverage between rural and urban populations is potentially incomplete. Fourth, only English language articles were included. Finally, recent changes in vaccine acceptability may reduce the reproducibility of studies conducted prior to the COVID-19 pandemic if repeated in the future.

5. Conclusion

This literature review synthesizes peer-reviewed research evaluating factors contributing to differences in vaccination coverage among rural-versus urban-dwelling adults. Research regarding low rural adult vaccine coverage garnered significant interest during the COVID-19 pandemic; however, attention on rural populations has greatly diminished despite the ongoing critical importance of ensuring parity in vaccine access and uptake for rural adults. Additionally, during the 2025 Measles Outbreak in the U.S., measles increasingly affected unvaccinated adults living in rural areas. Investing in initiatives that improve patient education and increase access to preventive health services can help protect rural communities from the spread of vaccine-preventable diseases. Furthermore, integrating these efforts with existing programs to prevent and treat chronic diseases can help foster positive attitudes toward immunization as part of a comprehensive approach to health.

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Data availability

Data will be made available on request.

Appendix A

Appendix Table 1

Search terms/strategy.

Database	Search Criteria
Medline	(vaccin* OR immuniz* OR immunis*).mp. OR immunization/ or exp vaccination/ or exp mass vaccination/ AND (rural* OR countryside* OR backcount* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)), mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*)).mp. OR exp Rural Health Services/ or exp Rural Health/ or exp Rural Population/ AND ((disparit* OR disparat* OR inequal* OR unequal* OR inequit* OR unequit* OR equity OR equities OR equality OR equalities OR disadvantag* OR facilitat* OR barrier* OR determinant*).mp. OR exp health inequities/ or exp gender equity/ or exp health status disparities/ or exp healthcare disparities/ or exp socioeconomic disparities in health/ or exp "social determinants of health") OR ((urban* OR city OR cities OR metro* OR municipal* OR suburb* OR megapolis OR innercity OR innerdies OR megadty OR megadties OR megaregion* OR superdty OR superdties OR conurbation* OR slum* OR ghetto*).mp. OR ((highly populat* OR high populat* OR most populat* OR densely populat* OR dense populat* OR large populat* OR built up* OR industrial*) adj4 (county OR counties OR area* OR communit* OR neighborhood* OR residence* OR town* OR region* OR province* OR

Database	Search Criteria
	setting*).mp. OR ((built up* OR industrial*) adj4 (population*)).mp. OR exp Urban Population/ or exp Urban Health/ AND (rural* OR countryside* OR backcount* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)), mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*)).mp. OR exp Rural Health Services/ or exp Rural Health/ or exp Rural Population/)) AND (America* OR united states* OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR hawai I OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR Louisiana OR Maine OR Maryland OR Massachusetts OR Michigan OR Minnesota OR Mississippi OR Missouri OR Montana OR Nebraska OR Nevada OR New Hampshire OR New Jersey OR New Mesdco OR New York OR North Carolina OR North Dakota OR Ohio OR Oklahoma OR Oregon OR Pennsylvania OR Rhode Island OR South Carolina OR South Dakota OR Tennessee OR Texas OR Utah OR Vermont OR Virginia OR Washington OR West Virginia OR Wisconsin OR Wyoming OR Maricopa County OR Orange County OR Miami OR Kings County OR Riverside County OR Cook County OR Harris County OR Appalachia* OR great lakes OR midatlantic* OR mid Atlantic* OR Midwest* OR mid west* OR new England OR great plains OR heartland OR deep south OR rust belt OR bible belt OR statewide* OR northeastern us* OR "northeastern u.s." OR "northeastern u.s.a." OR "northeastern state*" OR northeast state* OR northeast us* OR "northeast u.s" OR "northeast u.s.a." OR "pacific northwest" OR northwestern us* OR "northwestern u.s" OR "northwestern u.s.a." OR "northwest u.s" OR "northwest u.s.a." OR northwest us* OR northwestern state* OR northwest state* OR pacific state* OR southeast state* OR southeastern state* OR southeast region OR southeastern region OR southeast us* OR southeastern us* OR "southeast u.s" OR "southeast u.s.a." OR "southeastern u.s" OR "southeastern u.s.a." OR southern state* OR southern us* OR "southern u.s" OR "southern u.s.a." OR southwest state* OR southwestern state* OR southwest us* OR southwestern us* OR "southwest u.s" OR "southwest u.s.a." OR "southwestern u.s" OR "southwestern u.s.a." OR eastern us OR eastern usa OR "eastern u.s" OR "eastern u.s.a." OR eastern state OR eastern states OR western us OR western usa OR "western u.s" OR "western u.s.a." OR western state OR western states OR Albany OR Albuquerque OR Anaheim OR anchorage OR ann arbor OR Annapolis OR Arlington OR Atlanta OR Austin OR Bakersfield OR Baltimore OR Bardstown OR baton rouge OR Berkeley OR Bethesda OR Boise OR boston OR Bozeman OR Burlington OR carson city OR Chicago OR chula vista OR Chesapeake OR Cincinnati OR Cleveland OR Columbus OR corpus Christi OR Dallas OR Denver OR des moines OR Detroit OR dover OR durham OR east landing OR el paso OR Evanston OR fair banks OR Farmington OR Flagstaff OR fort wayne OR fresno OR Fremont OR Gainesville OR Glendale OR Greensboro OR Harrisburg OR Hartford OR Harvard OR Hershey OR Honolulu OR Houston OR Indianapolis OR Irvine OR Jacksonville OR Jefferson dty OR jersey city OR johns Hopkins OR Juneau OR Las Vegas OR lansing OR Laredo OR Lesdngton OR Lincoln OR little rock OR long beach OR Louisville OR Los Angeles OR Lubbock OR Memphis OR Miami OR Milwaukee OR Minneapolis OR Missoula OR Montgomery OR Montpelier OR Nashville OR Newark OR New Hampshire OR new haven OR new Orleans OR nyc OR Oakland OR Omaha OR Orono OR Orlando OR Phoenix OR Philadelphia OR Pittsburgh OR Portland OR providence OR Raleigh OR reno OR Rochester OR Rockville OR sacramento OR salem OR salt lake dty OR santa ana OR santa clarita OR san bernardino OR st paul OR saint paul OR st louis OR saint louis OR San Antonio OR San Diego OR san Francisco* OR San Jose OR sante fe OR scottsdale OR Seattle OR Shreveport OR Springfield OR spokane OR Stanford OR Stockton OR Tampa OR Tallahassee OR topeka OR tula OR Tuscon OR Urbana OR Vail OR West Lafayette OR Wichita OR Wilmington OR samoa* OR Tutuila* OR pago pago OR guam* OR hagatna OR northern mariana island* OR north mariana island* OR saipan OR Puerto rico* OR Puerto rican* OR sanjuan* OR virgin island* OR Charlotte Amalie OR saint croix island* OR saint john island* OR saint Thomas island*).mp.af,in,pl, kf. OR exp United States/ NOT ((exp infant/ OR exp child/ OR adolescent/) NOT exp adult/) Limits: 2000-, exclude animals, English
Em base	(vaccin* OR immuniz* OR immunis*).mp. OR immunization/ or exp vaccination/ AND (rural* OR countryside* OR backcount* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)), mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*)).mp. OR exp rural health/ or exp

Database	Search Criteria
	rural population/ or exp rural area/ or exp rural hospital/ or exp rural health care/ or exp urban rural difference/
	AND
	((disparit* OR disparat* OR inequal* OR unequal* OR inequit* OR unequit* OR equity OR equities OR equality OR equalities OR disadvantag* OR facilitat* OR barrier* OR determinant*).mp. OR exp health disparity/ or exp health care disparity/ or exp racial disparity/ or exp social inequality/ OR exp "social determinants of health"/ OR exp urban rural difference/
	OR
	((urban* OR city OR cities OR metro* OR municipal* OR suburb* OR megapolis OR innercity OR innerdities OR megadty OR megadties OR megaregion* OR superdty OR superdties OR conurbation* OR slum* OR ghetto*).mp. OR ((highly populat* OR high populat* OR most populat* OR densely populat* OR dense populat* OR large populat* OR built up* OR industrial*) adj4 (county OR counties OR area* OR communit* OR neighborhood* OR residence* OR town* OR region* OR province* OR setting*).mp. OR ((built up* OR industrial*) adj4 (population*).mp. or exp urban hospital/ or exp urban area/ or exp urban health/ or exp urban population/
	AND
	(rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*).mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*).mp. OR exp rural health/ or exp rural population/ or exp rural area/ or exp rural hospital/ or exp rural health care/))
	AND
	(America* OR united states* OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR hawai I OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR Louisiana OR Maine OR Maryland OR Massachusetts OR Michigan OR Minnesota OR Mississippi OR Missouri OR Montana OR Nebraska OR Nevada OR New Hampshire OR New Jersey OR New Mesdco OR New York OR North Carolina OR North Dakota OR Ohio OR Oklahoma OR Oregon OR Pennsylvania OR Rhode Island OR South Carolina OR South Dakota OR Tennessee OR Texas OR Utah OR Vermont OR Virginia OR Washington OR West Virginia OR Wisconsin OR Wyoming OR Maricopa County OR Orange County OR Miami OR Kings County OR Riverside County OR Cook County OR Harris County OR Appalachia* OR great lakes OR midatlantic* OR mid Atlantic* OR Midwest* OR mid west* OR new England OR great plains OR heartland OR deep south OR rust belt OR bible belt OR statewide* OR northeastern us* OR "northeastern u.s" OR "northeastern u.s.a." OR northeastern state* OR northeast state* OR northeast us* OR "northeast u.s" OR "northeast u.s.a." OR "pacific northwest" OR northwestern us* OR "northwestern u.s" OR "northwestern u.s.a." OR "northwest u.s" OR "northwest u.s.a." OR northwest us* OR northwestern state* OR northwest state* OR pacific state* OR southeast state* OR southeastern state* OR southeast region OR southeastern region OR southeast us* OR southeastern us* OR "southeast u.s" OR "southeast u.s.a." OR "southeastern u.s" OR "southeastern u.s.a." OR southern state* OR southern us* OR "southern u.s" OR "southern u.s.a." OR southwest state* OR southwestern state* OR southwest us* OR southwestern us* OR "southwest u.s" OR "southwest u.s.a." OR "southwestern u.s" OR "southwestern u.s.a." OR eastern us OR eastern usa OR "eastern u.s" OR "eastern u.s.a." OR eastern state OR eastern states OR western us OR western usa OR "western u.s" OR "western u.s.a." OR western state OR western states OR Albany OR Albuquerque OR Anaheim OR anchorage OR ann arbor OR Annapolis OR Arlington OR Atlanta OR Austin OR Bakersfield OR Baltimore OR Bardstown OR baton rouge OR Berkeley OR Bethesda OR Boise OR boston OR Bozeman OR Burlington OR carson city OR Chicago OR chula vista OR Chesapeake OR Cincinnati OR Cleveland OR Columbus OR corpus Christi OR Dallas OR Denver OR des moines OR Detroit OR dover OR durham OR east landing OR el paso OR Evanston OR fair banks OR Farmington OR Flagstaff OR fort wayne OR fresno OR Fremont OR Gainesville OR Glendale OR Greensboro OR Harrisburg OR Hartford OR Harvard OR Hershey OR Honolulu OR Houston OR Indianapolis OR Irvine OR Jacksonville OR Jefferson dtty OR jersey city OR johns Hopkins OR Juneau OR Las Vegas OR lansing OR Laredo OR Lesdngton OR Lincoln OR little rock OR long beach OR Louisville OR Los Angeles OR Lubbock OR Memphis OR Miami OR Milwaukee OR Minneapolis OR Missoula OR Montgomery OR Montpelier OR Nashville OR Newark OR New Hampshire OR new haven OR new Orleans OR nyc OR Oakland OR Omaha OR Orono OR Orlando OR Phoenix OR Philadelphia OR Pittsburgh OR Portland OR providence OR Raleigh OR reno OR Rochester OR Rockville OR sacramento OR salem OR salt lake dty OR santa ana OR santa clarita OR san bernardino OR st paul OR saint paul OR st louis OR saint louis OR San Antonio OR San Diego OR san Francisco* OR San Jose OR sante fe OR scottsdale OR Seattle OR Shreveport OR Springfield OR spokane OR Stanford OR Stockton OR Tampa OR Tallahassee OR topeka OR tuscon OR Urbana OR Vail OR West Lafayette OR Wichita OR Wilmington OR samoa* OR Tutuila* OR pago pago OR guam* OR hagatna OR northern mariana island* OR north mariana island* OR saipan OR Puerto rico* OR Puerto rican* OR sanjuan* OR virgin island* OR Charlotte Amalie OR saint croix island* OR saint john island* OR saint Thomas island*).mp,cp,in,kf. OR exp United States/

Database	Search Criteria
Global Health	NOT
	((exp infant/ OR exp child/ OR adolescent/) NOT exp adult/)
	Limits: 2000-, exclude animals, English
	(vaccin* OR immuniz* OR immunis*).mp. OR immunization/ or exp vaccination/ or exp mass vaccination/
	AND
	(rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)), mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*)).mp. OR exp rural urban relations/ or exp rural women/ or exp rural areas/ or exp rural health/ or exp rural population/ or exp rural communities/ or exp rural society/
	AND
	((disparit* OR disparat* OR inequal* OR unequal* OR inequit* OR unequit* OR equity OR equities OR equality OR equalities OR disadvantage* OR facilitat* OR barrier* OR determinant*).mp. OR exp disparity/ or exp health inequalities/ OR exp health determinants/ OR exp rural urban relations/
	OR
	((rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)), mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*)).mp. OR exp rural women/ or exp rural areas/ or exp rural health/ or exp rural population/ or exp rural communities/ or exp rural society/
	AND
	(urban* OR city OR cities OR metro* OR municipal* OR suburb* OR megapolis OR innerdty OR innerdies OR megadty OR megacities OR megaregion* OR superdty OR superdies OR conurbation* OR slum* OR ghetto*).mp. OR ((highly populat* OR high populat* OR most populat* OR densely populat* OR dense populat* OR large populat* OR built up* OR industrial*) adj4 (county OR counties OR area* OR communit* OR neighborhood* OR residence* OR town* OR region* OR province* OR setting*)),mp. OR ((built up* OR industrial*) adj4 (population*)).mp. OR exp urban areas/ or exp urban environment/ or exp urban population/))
	AND
	(America* OR united states* OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR hawai I OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR Louisiana OR Maine OR Maryland OR Massachusetts OR Michigan OR Minnesota OR Mississippi OR Missouri OR Montana OR Nebraska OR Nevada OR New Hampshire OR New Jersey OR New Mesdco OR New York OR North Carolina OR North Dakota OR Ohio OR Oklahoma OR Oregon OR Pennsylvania OR Rhode Island OR South Carolina OR South Dakota OR Tennessee OR Texas OR Utah OR Vermont OR Virginia OR Washington OR West Virginia OR Wisconsin OR Wyoming OR Maricopa County OR Orange County OR Miami OR Kings County OR Riverside County OR Cook County OR Harris County OR Appalachia* OR great lakes OR midatlantic* OR mid Atlantic* OR Midwest* OR mid west* OR new England OR great plains OR heartland OR deep south OR rust belt OR bible belt OR statewide* OR northeastern us* OR "northeastern u.s" OR "northeastern u.s.a." OR northeastern state* OR northeast state* OR northeast us* OR "northeast u.s" OR "northeast u.s.a." OR "pacific northwest" OR northwestern us* OR "northwestern u.s" OR "northwestern u.s.a." OR "northwest u.s" OR "northwest u.s.a." OR northwest us* OR northwestern state* OR northwest state* OR pacific state* OR southeast state* OR southeastern state* OR southeast region OR southeastern region OR southeast us* OR southeastern us* OR "southeast u.s" OR "southeast u.s.a." OR "southeastern u.s" OR "southeastern u.s.a." OR southern state* OR southern us* OR "southern u.s" OR "southern u.s.a." OR southwest state* OR southwestern state* OR southwest us* OR southwestern us* OR "southwest u.s" OR "southwest u.s.a." OR "southwestern u.s" OR "southwestern u.s.a." OR eastern us OR eastern usa OR "eastern u.s" OR "eastern u.s.a." OR eastern state OR eastern states OR western us OR western usa OR "western u.s" OR "western u.s.a." OR western state OR western states OR Albany OR Albuquerque OR Anaheim OR anchorage OR ann arbor OR Annapolis OR Arlington OR Atlanta OR Austin OR Bakersfield OR Baltimore OR Bardstown OR baton rouge OR Berkeley OR Bethesda OR Boise OR boston OR Bozeman OR Burlington OR carson city OR Chicago OR chula vista OR Chesapeake OR Cincinnati OR Cleveland OR Columbus OR corpus Christi OR Dallas OR Denver OR des moines OR Detroit OR dover OR durham OR east landing OR el paso OR Evanston OR fair banks OR Farmington OR Flagstaff OR fort wayne OR fresno OR Fremont OR

Database	Search Criteria
	Gainesville OR Glendale OR Greensboro OR Harrisburg OR Hartford OR Harvard OR Hershey OR Honolulu OR Houston OR Indianapolis OR Irvine OR Jacksonville OR Jefferson OR jersey city OR johns Hopkins OR Juneau OR Las Vegas OR lansing OR Laredo OR Lesdngton OR Lincoln OR little rock OR long beach OR Louisville OR Los Angeles OR Lubbock OR Memphis OR Miami OR Milwaukee OR Minneapolis OR Missoula OR Montgomery OR Montpelier OR Nashville OR Newark OR New Hampshire OR new haven OR new Orleans OR nyc OR Oakland OR Omaha OR Orono OR Orlando OR Phoenix OR Philadelphia OR Pittsburgh OR Portland OR providence OR Raleigh OR reno OR Rochester OR Rockville OR sacramento OR salem OR salt lake OR santa ana OR santa clarita OR san bernardino OR st paul OR saint paul OR st louis OR saint louis OR San Antonio OR San Diego OR san Francisco* OR San Jose OR sante fe OR scottsdale OR Seattle OR Shreveport OR Springfield OR spokane OR Stanford OR Stockton OR Tampa OR Tallahassee OR topeka OR tula OR Tuscon OR Urbana OR Vail OR West Lafayette OR Wichita OR Wilmington OR samoa* OR Tutuila* OR pago pago OR guam* OR hagatna OR northern mariana island* OR north mariana island* OR saipan OR Puerto rico* OR Puerto rican* OR sanjuan* OR virgin island* OR Charlotte Amalie OR saint croix island* OR saint john island* OR saint Thomas island*).mp,gl,cp,in. OR USA.gl. NOT ((exp infants/ OR exp children/ OR adolescents/) NOT exp adults/) Limits: 2000-, English
PsychInfo	(vaccin* OR immuniz* OR immunis*).mp. OR immunization/ or exp vaccination/ AND (rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)). mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*)).mp. OR exp Rural Health/ or exp Rural Environments/ AND ((disparit* OR disparat* OR inequal* OR unequal* OR inequit* OR unequit* OR equity OR equities OR equality OR equalities OR disadvantag* OR facilitat* OR barrier* OR determinant*).mp. OR exp equity/ or exp health disparities/ OR ((rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR non metro* OR Appalachia* OR regional health* OR geographically isolat*).mp. OR ((frontier* OR remote* OR isolated* OR farming* OR low populat* OR least populat* OR sparse populat* OR sparsely populat* OR small populat*) adj4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)). mp. OR ((frontier* OR remote* OR isolated* OR farming*) adj4 (population*)).mp. OR exp Rural Health/ or exp Rural Environments/ AND (urban* OR city OR cities OR metro* OR munidpal* OR suburb* OR megapolis OR innerdty OR innerdities OR megadty OR megacities OR megaregion* OR superdty OR superdities OR conurbation* OR slum* OR ghetto*).mp. OR ((highly populat* OR high populat* OR most populat* OR densely populat* OR dense populat* OR large populat* OR built up* OR industrial*) adj4 (county OR counties OR area* OR communit* OR neighborhood* OR residence* OR town* OR region* OR province* OR setting*)).mp. OR ((built up* OR industrial*) adj4 (population*)).mp. OR exp Urban Health/ or exp Urban Environments/)) AND (America* OR united states* OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR hawai I OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR Louisiana OR Maine OR Maryland OR Massachusetts OR Michigan OR Minnesota OR Mississippi OR Missouri OR Montana OR Nebraska OR Nevada OR New Hampshire OR New Jersey OR New Mesdco OR New York OR North Carolina OR North Dakota OR Ohio OR Oklahoma OR Oregon OR Pennsylvania OR Rhode Island OR South Carolina OR South Dakota OR Tennessee OR Texas OR Utah OR Vermont OR Virginia OR Washington OR West Virginia OR Wisconsin OR Wyoming OR Maricopa County OR Orange County OR Miami OR Kings County OR Riverside County OR Cook County OR Harris County OR Appalachia* OR great lakes OR midatlantic* OR mid Atlantic* OR Midwest* OR mid west* OR new England OR great plains OR heartland OR deep south OR rust belt OR bible belt OR statewide* OR northeastern us* OR "northeastern u.s" OR "northeastern u.s.a." OR northeastern state* OR northeast state* OR northeast us* OR "northeast u.s" OR "northeast u.s.a." OR "pacific northwest" OR northwestern us* OR "northwestern u.s" OR "northwestern u.s.a." OR "northwest u.s" OR "northwest u.s.a." OR northwest us* OR northwestern

Database	Search Criteria
	state* OR northwest state* OR pacific state* OR southeast state* OR southeastern state* OR southeast region OR southeastern region OR southeast us* OR southeastern us* OR "southeast u.s" OR "southeast u.s.a." OR "southeastern u.s" OR "southeastern u.s.a." OR southern state* OR southern us* OR "southern u.s" OR "southern u.s.a." OR southwest state* OR southwestern state* OR southwest us* OR southwestern us* OR "southwest u.s" OR "southwest u.s.a." OR "southwestern u.s" OR "southwestern u.s.a." OR eastern us OR eastern usa OR "eastern u.s" OR "eastern u.s.a." OR eastern state OR eastern states OR western us OR western usa OR "western u.s" OR "western u.s.a." OR western state OR western states OR Albany OR Albuquerque OR Anaheim OR anchorage OR ann arbor OR Annapolis OR Arlington OR Atlanta OR Austin [S1] AND [S2] AND [S5] AND [S8] OR Bakersfield OR Baltimore OR Bardstown OR baton rouge OR Berkeley OR Bethesda OR Boise OR boston OR Bozeman OR Burlington OR carson dty OR Chicago OR chula vista OR Chesapeake OR Cincinnati OR Cleveland OR Columbus OR corpus Christi OR Dallas OR Denver OR des moines OR Detroit OR dover OR durham OR east lansing OR el paso OR Evanston OR fairbanks OR Farmington OR Flagstaff OR fort wayne OR fresno OR Fremont OR Gainesville OR Glendale OR Greensboro OR Harrisburg OR Hartford OR Harvard OR Hershey OR Honolulu OR Houston OR Indianapolis OR Irvine OR Jacksonville OR Jefferson dty OR jersey city OR Johns Hopkins OR Juneau OR Las Vegas OR lansing OR Laredo OR Lesdngton OR Lincoln OR little rock OR long beach OR Louisville OR Los Angeles OR Lubbock OR Memphis OR Miami OR Milwaukee OR Minneapolis OR Missoula OR Montgomery OR Montpelier OR Nashville OR Newark OR New Hampshire OR new haven OR new Orleans OR nyc OR Oakland OR Omaha OR Orono OR Orlando OR Phoenix OR Philadelphia OR Pittsburgh OR Portland OR providence OR Raleigh OR reno OR Rochester OR Rockville OR sacramento OR salem OR salt lake city OR santa ana OR santa clarita OR san bernardino OR st paul OR saint paul OR st louis OR saint louis OR San Antonio OR San Diego OR san Francisco* OR San Jose OR sante fe OR scottsdale OR Seattle OR Shreveport OR Springfield OR spokane OR Stanford OR Stockton OR Tampa OR Tallahassee OR topeka OR tula OR Tuscon OR Urbana OR Vail OR West Lafayette OR Wichita OR Wilmington OR samoa* OR Tutuila* OR pago pago OR guam* OR hagatna OR northern mariana island* OR north mariana island* OR saipan OR Puerto rico* OR Puerto rican* OR sanjuan* OR virgin island* OR Charlotte Amalie OR saint croix island* OR saint john island* OR saint Thomas island*).mp,lo. NOT ((baby OR babies OR infant* OR newborn* OR neonat* OR child* OR kid OR kids OR toddler* OR teen* OR adolescen*).sh.) NOT (adult* OR women* OR woman* OR men OR man OR maternal* OR paternal* OR elder* OR geriatric* OR pregnan* OR mother* OR father* OR parent* OR mom OR moms OR dad OR dads OR "middle aged" OR retiree* OR population* OR communit* OR cohort*).sh. Limits: 2000-, English Cochrane Library (vaccin* OR immuniz* OR immunis*):ti,ab AND (rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR "non metro" OR "non metropolitan" OR Appalachia* OR "regional health" OR "geographically isolated"):ti,ab OR ((frontier* OR remote* OR isolated* OR farming* OR "low population" OR "least populated" OR "sparse population" OR "sparsely populated" OR "small population") NEAR/4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)):ti,ab OR ((frontier* OR remote* OR isolated* OR farming*) NEAR/4 (population*)):ti,ab AND ((disparit* OR disparat* OR inequal* OR unequal* OR inequit* OR unequit* OR equity OR equities OR equality OR equalities OR disadvantag* OR facilitat* OR barrier* OR determinant*):ti,ab OR ((rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR "non metro" OR "non metropolitan" OR Appalachia* OR "regional health" OR "geographically isolated"):ti,ab OR ((frontier* OR remote* OR isolated* OR farming* OR "low population" OR "least populated" OR "sparse population" OR "sparsely populated" OR "small population") NEAR/4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)):ti,ab OR ((frontier* OR remote* OR isolated* OR farming*) NEAR/4 (population*)):ti,ab AND (urban* OR city OR cities OR metro* OR municipal* OR suburb* OR megapolis OR innerdty OR innerdities OR megadty OR megacities OR megaregion* OR superdty OR superdities OR conurbation* OR slum* OR ghetto*):ti,ab OR (("highly populated" OR "high population" OR "most populated" OR "densely populated" OR "dense population" OR "large population" OR "built up" OR industrial*) NEAR/4 (county OR counties OR area* OR communit* OR neighborhood* OR residence* OR town* OR region* OR province* OR setting*)):ti,ab OR (("built up" OR industrial*) NEAR/4 (population*)):ti,ab AND

Database	Search Criteria
Author Manuscript	(America* OR "united states" OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR "hawai i" OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR Louisiana OR Maine OR Maryland OR Massachusetts OR Michigan OR Minnesota OR Mississippi OR Missouri OR Montana OR Nebraska OR Nevada OR "New Hampshire" OR "New Jersey" OR "New Mexico" OR "New York" OR "North Carolina" OR "North Dakota" OR Ohio OR Oklahoma OR Oregon OR Pennsylvania OR "Rhode Island" OR "South Carolina" OR "South Dakota" OR Tennessee OR Texas OR Utah OR Vermont OR Virginia OR Washington OR "West Virginia" OR Wisconsin OR Wyoming OR "Maricopa County" OR "Orange County" OR "Kings County" OR "Riverside County" OR "Cook County" OR "Harris County" OR Appalachia* OR "great lakes" OR midatlantic* OR "mid Atlantic" OR Midwest* OR "mid west" OR "new England" OR "great plains" OR heartland OR "deep south" OR "rust belt" OR "bible belt" OR statewide* OR "northeastern us" OR "northeastern usa" OR "northeastern u.s" OR "northeastern u.s.a." OR "northeastern state" OR "northeast state" OR "northeastern states" OR "northeast states" OR "northeast us" OR "northeast usa" OR "northeast u.s" OR "northeast u.s.a." OR "pacific northwest" OR "northwestern us" OR "northwestern usa" OR "northwestern u.s" OR "northwestern u.s.a." OR "northwest u.s" OR "northwest u.s.a." OR "northwest us" OR "northwest usa" OR "northwestern state" OR "northwest state" OR "northwestern states" OR "northwest states" OR "pacific states" OR "southeast state" OR "southeastern state" OR "southeast states" OR "southeastern states" OR "southeast region" OR "southeastern region" OR "southeast us" OR "Southeast usa" OR "southeastern us" OR "southeastern usa" OR "southeast u.s" OR "southeast u.s.a." OR "southeastern u.s" OR "southeastern u.s.a." OR "southern state" OR "southern states" OR "southern us" OR "southern usa" OR "southern u.s" OR "southern u.s. a." OR "southwest state" OR "southwest states" OR "southwestern state" OR "southwestern states" OR "southwest us" OR "southwest usa" OR "southwestern us" OR "southwestern usa" OR "southwest u.s" OR "southwest u.s.a." OR "southwestern u.s" OR "southwestern u.s.a." OR "eastern us" OR "eastern usa" OR "eastern u.s" OR "eastern u.s.a." OR "eastern state" OR "eastern states" OR "western us" OR "western usa" OR "western u.s" OR "western u.s.a." OR "western state" OR "western states" OR Albany OR Albuquerque OR Anaheim OR anchorage OR "ann arbor" OR Annapolis OR Arlington OR Atlanta OR Austin OR Bakersfield OR Baltimore OR Bardstown OR "baton rouge" OR Berkeley OR Bethesda OR Boise OR boston OR Bozeman OR Burlington OR "carson dty" OR Chicago OR "chula vista" OR Chesapeake OR Cincinnati OR Cleveland OR Columbus OR "corpus Christi" OR Dallas OR Denver OR "des moines" OR Detroit OR dover OR durham OR "east lansing" OR "el paso" OR Evanston OR fair banks OR Farmington OR Flagstaff OR "fort wayne" OR fresno OR Fremont OR Gainesville OR Glendale OR Greensboro OR Harrisburg OR Hartford OR Harvard OR Hershey OR Honolulu OR Houston OR Indianapolis OR Irvine OR Jacksonville OR "Jefferson dty" OR "jersey city" OR "johns Hopkins" OR Juneau OR "Las Vegas" OR lansing OR Laredo OR Lexington OR Lincoln OR "little rock" OR "long beach" OR Louisville OR "Los Angeles" OR Lubbock OR Memphis OR Miami OR Milwaukee OR Minneapolis OR Missoula OR Montgomery OR Montpelier OR Nashville OR Newark OR "New Hampshire" OR "new haven" OR "new Orleans" OR nyc OR Oakland OR Omaha OR Orono OR Orlando OR Phoenix OR Philadelphia OR Pittsburgh OR Portland OR providence OR Raleigh OR reno OR Rochester OR Rockville OR sacramento OR salem OR "salt lake city" OR "santa ana" OR "santa clarita" OR "san Bernardino" OR "st paul" OR "saint paul" OR "st louis" OR "saint louis" OR "San Antonio" OR "San Diego" OR "san Frandsco" OR "San Jose" OR "sante fe" OR scottsdale OR Seattle OR Shreveport OR Springfield OR spokane OR Stanford OR Stockton OR Tampa OR Tallahassee OR topeka OR tula OR Tucson OR Urbana OR Vail OR "West Lafayette" OR Wichita OR Wilmington OR samoa OR Tutuila OR "pago pago" OR guam OR hagatna OR "northern mariana island" OR "northern mariana islands" OR "north mariana island" OR "north mariana islands" OR saipan OR "Puerto rico" OR "Puerto rican" OR "Puerto ricans" OR "san juan" OR "virgin island" OR "virgin islands" OR "Charlotte Amalie" OR "saint croix island" OR "saint john island" OR "saint Thomas island");ti,ab OR MeSH descriptor: [United States] explode all trees
Author Manuscript	NOT
Author Manuscript	((MeSH descriptor: [Infant] explode all trees OR MeSH descriptor: [Child] explode all trees OR MeSH descriptor: [Adolescent] explode all trees) NOT MeSH descriptor: [Adult] explode all trees
Author Manuscript	Limits: 2000-, English
Scopus	TITLE-ABS-KEY(vaccin* OR immuniz* OR immunis*)
Author Manuscript	AND
Author Manuscript	TITLE-ABS-KEY(rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR "non metro" OR "non metropolitan" OR Appalachia* OR "regional health" OR "geographically isolated") OR TITLE-ABS-KEY((frontier* OR remote* OR isolated* OR forming* OR "low population" OR "least populated" OR "sparse population" OR "sparsely populated" OR "small population") W/4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)) OR TITLE-ABS-KEY((frontier* OR remote* OR isolated* OR farming*) W/4 (population*))
Author Manuscript	AND
Author Manuscript	(TITLE-ABS-KEY(disparit* OR disparat* OR inequal* OR unequal* OR inequit* OR unequit* OR equity OR equities OR equality OR equalities OR disadvantag* OR fedlitat* OR barrier* OR determinant*))

Database	Search Criteria
	OR
	(TITLE-ABS-KEY(rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR "non metro" OR "non metropolitan" OR Appalachia* OR "regional health" OR "geographically isolated") OR TITLE-ABS-KEY((frontier* OR remote* OR isolated* OR farming* OR "low population" OR "least populated" OR "sparse population" OR "sparsely populated" OR "small population") W/4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)) OR TITLE-ABS-KEY((frontier* OR remote* OR isolated* OR farming*) W/4 (population*))
	AND
	TITLE-ABS-KEY(Curban* OR dty OR cities OR metro* OR municipal* OR suburb* OR megapolis OR innerdty OR innerdities OR megadty OR megadities OR megaregion* OR superdty OR supercities OR conurbation* OR slum* OR ghetto*) OR TITLE-ABS-KEY(("highly populated" OR "high population" OR "most populated" OR "densely populated" OR "dense population" OR "large population" OR "built up" OR industrial*) W/4 (county OR counties OR area* OR communit* OR neighborhood* OR residence* OR town* OR region* OR province* OR setting*)) OR TITLE-ABS-KEY(("built up" OR industrial*) W/4 (population*))
	AND
	TITLE-ABS-KEY(America* OR "united states" OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR "hawai i" OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR Louisiana OR Maine OR Maryland OR Massachusetts OR Michigan OR Minnesota OR Mississippi OR Missouri OR Montana OR Nebraska OR Nevada OR "New Hampshire" OR "New Jersey" OR "New Mexico" OR "New York" OR "North Carolina" OR "North Dakota" OR Ohio OR Oklahoma OR Oregon OR Pennsylvania OR "Rhode Island" OR "South Carolina" OR "South Dakota" OR Tennessee OR Texas OR Utah OR Vermont OR Virginia OR Washington OR "West Virginia" OR Wisconsin OR Wyoming OR "Maricopa County" OR "Orange County" OR "Kings County" OR "Riverside County" OR "Cook County" OR "Harris County" OR Appalachia* OR "great lakes" OR midatlantic* OR "mid Atlantic" OR Midwest* OR "mid west" OR "new England" OR "great plains" OR heartland OR "deep south" OR "rust belt" OR "bible belt" OR statewide* OR "northeastern us" OR "northeastern usa" OR "northeastern u.s" OR "northeastern u.s.a." OR "northeastern state" OR "northeast state" OR "northeastern states" OR "northeast states" OR "northeast us" OR "northeast usa" OR "northeast u.s" OR "northeast u.s.a." OR "pacific northwest" OR "northwestern us" OR "northwestern usa" OR "northwestern u.s" OR "northwestern u.s.a." OR "northwest u.s" OR "northwest u.s.a." OR "northwest us" OR "northwest usa" OR "northwestern state" OR "northwest state" OR "northwestern states" OR "northwest states" OR "padfic state" OR "pacific states" OR "southeast state" OR "southeastern state" OR "southeast states" OR "southeastern states" OR "southeast region" OR "southeastern region" OR "southeast us" OR "Southeast usa" OR "southeastern us" OR "southeastern usa" OR "southeast u.s" OR "southeast u.s.a." OR "southeastern u.s" OR "southeastern u.s.a." OR "southern state" OR "southern states" OR "southern us" OR "southern usa" OR "southern u.s" OR "southern u.s.a." OR "southwest state" OR "southwest states" OR "southwestern state" OR "southwestern states" OR "southwest us" OR "southwest usa" OR "southwestern us" OR "southwestern usa" OR "southwest u.s" OR "southwest u.s.a." OR "southwestern u.s" OR "southwestern u.s.a." OR "eastern us" OR "eastern usa" OR "eastern u.s" OR "eastern u.s.a." OR "eastern state" OR "eastern states" OR "western us" OR "western usa" OR "western u.s" OR "western u.s.a." OR "western state" OR "western states" OR Albany OR Albuquerque OR Anaheim OR anchorage OR "ann arbor" OR Annapolis OR Arlington OR Atlanta OR Austin OR Bakersfield OR Baltimore OR Bardstown OR "baton rouge" OR Berkeley OR Bethesda OR Boise OR boston OR Bozeman OR Burlington OR "carson dty" OR Chicago OR "chula vista" OR Chesapeake OR Cincinnati OR Cleveland OR Columbus OR "corpus Christi" OR Dallas OR Denver OR "des moines" OR Detroit OR dover OR durham OR "east lansing" OR "el paso" OR Evanston OR fair banks OR Farmington OR Flagstaff OR "fort wayne" OR fresno OR Fremont OR Gainesville OR Glendale OR Greensboro OR Harrisburg OR Hartford OR Harvard OR Hershey OR Honolulu OR Houston OR Indianapolis OR Irvine OR Jacksonville OR "Jefferson dty" OR "jersey dty" OR "johns Hopkins" OR Juneau OR "Las Vegas" OR lansing OR Laredo OR Lexington OR Lincoln OR "little rock" OR "long beach" OR Louisville OR "Los Angeles" OR Lubbock OR Memphis OR Miami OR Milwaukee OR Minneapolis OR Missoula OR Montgomery OR Montpelier OR Nashville OR Newark OR "New Hampshire" OR "new haven" OR "new Orleans" OR nyc OR Oakland OR Omaha OR Orono OR Orlando OR Phoenix OR Philadelphia OR Pittsburgh OR Portland OR providence OR Raleigh OR reno OR Rochester OR Rockville OR sacramento OR salem OR "salt lake dty" OR "santa ana" OR "santa clarita" OR "san Bernardino" OR "st paul" OR "saint paul" OR "st louis" OR "saint louis" OR "San Antonio" OR "San Diego" OR "san Francisco" OR "San Jose" OR "sante fe" OR scottsdale OR Seattle OR Shreveport OR Springfield OR spokane OR Stanfod OR Stockton OR Tampa OR Tallahassee OR topeka OR tula OR Tuscon OR Urbana OR Vail OR "West Lafayette" OR Wichita OR Wilmington OR samoa OR Tutuila OR "pago pago" OR guam OR hagatna OR "northern mariana island" OR "northern mariana islands" OR "north mariana island" OR "north mariana islands" OR saipan OR "Puerto rico" OR "Puerto rican" OR "Puerto ricans" OR "san juan" OR "virgin island" OR "virgin islands" OR "Charlotte Amalie" OR "saint croix island" OR "saint john island" OR "saint Thomas island") OR AFFIL(America* OR "united states" OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR "hawai i" OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR

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GNAHL	TI,AB,SU (vaccin* OR immuniz* OR immunis*) AND TI,AB,SU (rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR "non metro" OR "non metropolitan" OR Appalachia* OR "regional health" OR "geographically isolated") OR ((frontier* OR remote* OR isolated* OR farming* OR "low population" OR "least populated" OR "sparse population" OR "sparsely populated" OR "small population") N4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)) OR ((frontier* OR remote* OR isolated* OR farming*) N4 (population*)) AND (TI,AB,SU (disparit* OR disparat* OR inequal* OR unequal* OR inequit* OR unequit* OR equity OR equities OR equality OR equalities OR disadvantag* OR facilitat* OR barrier* OR determinant*)) (TI,AB,SU (rural* OR countryside* OR backcountr* OR backwater* OR nonmetro* OR "non metro" OR "non metropolitan" OR Appalachia* OR "regional health" OR "geographically isolated") OR ((frontier* OR remote* OR isolated* OR farming* OR "low population" OR "least populated" OR "sparse population" OR "sparsely populated" OR "small population") N4 (county OR counties OR settlement* OR area* OR communit* OR neighborhood* OR residence* OR town* OR village* OR region* OR province* OR setting*)) OR ((frontier* OR remote* OR isolated* OR farming*) N4 (population*)) AND TI,AB,SU (urban* OR city OR cities OR metro* OR municipal* OR suburb* OR megapolis OR innerdty OR innercities OR megadty OR megacities OR megaregion* OR supercity OR superdties OR conurbation* OR slum* OR ghetto*) OR ((highly populated" OR "high population" OR "most populated" OR "densely populated" OR "dense population" OR "large population" OR "built up" OR industrial*) N4 (county OR counties OR area* OR communit* OR neighborhood* OR residence* OR town* OR region* OR province* OR setting*)) OR ((built up" OR industrial*) N4 (population*)))) AND TI,AB,SU(America* OR "united states" OR usa OR "u.s.a" OR "u.s." OR Alabama OR Alaska OR Appalachia* OR Arizona OR Arkansas OR California OR Colorado OR Connecticut OR Delaware OR "district of Columbia" OR Florida OR Georgia OR Hawaii OR "hawai i" OR Idaho OR Illinois OR Indiana OR Iowa OR Kansas OR Kentucky OR Louisiana OR Maine OR Maryland OR Massachusetts OR Michigan OR Minnesota OR Mississippi OR Missouri OR Montana OR Nebraska OR Nevada OR "New Hampshire" OR "New Jersey" OR "New Mexico" OR "New York" OR "North Carolina" OR "North Dakota" OR Ohio OR Oklahoma OR Oregon OR Pennsylvania OR "Rhode Island" OR "South Carolina" OR "South Dakota" OR Tennessee OR Texas OR Utah OR Vermont OR Virginia OR Washington OR "West Virginia" OR Wisconsin OR Wyoming OR "Maricopa County" OR "Orange County" OR "Kings County" OR "Riverside County" OR "Cook County" OR "Harris County" OR Appalachia* OR "great lakes" OR midatlantic* OR "mid Atlantic" OR Midwest* OR "mid west" OR

Database	Search Criteria
	“new England” OR “great plains” OR heartland OR “deep south” OR “rust belt” OR “bible belt” OR statewide* OR “northeastern us” OR “northeastern usa” OR “northeastern u.s” OR “northeastern u.s.a” OR “northeastern state” OR “northeast state” OR “northeast states” OR “northeast states” OR “northeast us” OR “northeast usa” OR “northeast u.s” OR “northeast u.s.a.” OR “pacific northwest” OR “northwestern us” OR “northwestern usa” OR “northwestern u.s” OR “northwestern u.s.a.” OR “northwest u.s” OR “northwest u.s.a.” OR “northwest us” OR “northwest usa” OR “northwestern state” OR “northwest state” OR “northwestern states” OR “northwest states” OR “padfic state” OR “pacific states” OR “southeast state” OR “southeastern state” OR “southeast states” OR “southeastern states” OR “southeast region” OR “southeastern region” OR “southeast us” OR “Southeast usa” OR “southeastern us” OR “southeastern usa” OR “southeast u.s” OR “southeast u.s.a.” OR “southeastern u.s” OR “southeastern u.s.a.” OR “southern state” OR “southern states” OR “southern us” OR “southern usa” OR “southern u.s” OR “southern u.s.a.” OR “southwest state” OR “southwest states” OR “southwestern state” OR “southwestern states” OR “southwest us” OR “southwest usa” OR “southwestern us” OR “southwestern usa” OR “southwest u.s” OR “southwest u.s.a.” OR “southwestern u.s” OR “southwestern u.s.a.” OR “eastern us” OR “eastern usa” OR “eastern u.s” OR “eastern u.s.a.” OR “eastern state” OR “eastern states” OR “western us” OR “western usa” OR “western u.s” OR “western u.s.a.” OR “western state” OR “western states” OR Albany OR Albuquerque OR Anaheim OR anchorage OR “ann arbor” OR Annapolis OR Arlington OR Atlanta OR Austin OR Bakersfield OR Baltimore OR Bardstown OR “baton rouge” OR Berkeley OR Bethesda OR Boise OR boston OR Bozeman OR Burlington OR “carson dty” OR Chicago OR “chula vista” OR Chesapeake OR Cincinnati OR Cleveland OR Columbus OR “corpus Christi” OR Dallas OR Denver OR “des moines” OR Detroit OR dover OR durham OR “east lansing” OR “el paso” OR Evanston OR fairbanks OR Farmington OR Flagstaff OR “fort wayne” OR fresno OR Fremont OR Gainesville OR Glendale OR Greensboro OR Harrisburg OR Hartford OR Harvard OR Hershey OR Honolulu OR Houston OR Indianapolis OR Irvine OR Jacksonville OR “Jefferson dty” OR “jersey dty” OR “johns Hopkins” OR Juneau OR “Las Vegas” OR lansing OR Laredo OR Lexington OR Lincoln OR “little rock” OR “long beach” OR Louisville OR “Los Angeles” OR Lubbock OR Memphis OR Miami OR Milwaukee OR Minneapolis OR Missoula OR Montgomery OR Montpelier OR Nashville OR Newark OR “New Hampshire” OR “new haven” OR “new Orleans” OR nyc OR Oakland OR Omaha OR Orono OR Orlando OR Phoenix OR Philadelphia OR Pittsburgh OR Portland OR providence OR Raleigh OR reno OR Rochester OR Rockville OR sacramento OR salem OR “salt lake dty” OR “santa ana” OR “santa darita” OR “san Bernardino” OR “st paul” OR “saint paul” OR “st louis” OR “saint louis” OR “San Antonio” OR “San Diego” OR “san Francisco” OR “San Jose” OR “sante fe” OR scottsdale OR Seattle OR Shreveport OR Springfield OR spokane OR Stanford OR Stockton OR Tampa OR Tallahassee OR topeka OR tula OR Tuscon OR Urbana OR Vail OR “West Lafayette” OR Wichita OR Wilmington OR samoa OR Tutuila OR “pago pago” OR guam OR hagatna OR “northern mariana island” OR “northern mariana islands” OR “north mariana island” OR “north mariana islands” OR saipan OR “Puerto rico” OR “Puerto rican” OR “Puerto ricans” OR “san juan” OR “virgin island” OR “virgin islands” OR “Charlotte Amalie” OR “saint croix island” OR “saint john island” OR “saint Thomas island”) AND NOT (MAIN SUBJECT (baby OR babies OR infant* OR newborn* OR neonat* OR child* OR kid OR kids OR toddler* OR teen* OR adolescen*)) NOT (adult* OR women* OR woman* OR men OR man OR maternal* OR paternal* OR elder* OR geriatric* OR pregnan* OR mother* OR father* OR parent* OR mom OR moms OR dad OR dads OR “middle aged” OR retiree* OR population* OR communit* OR cohort*) Limits: 2000-, English, peer-reviewed

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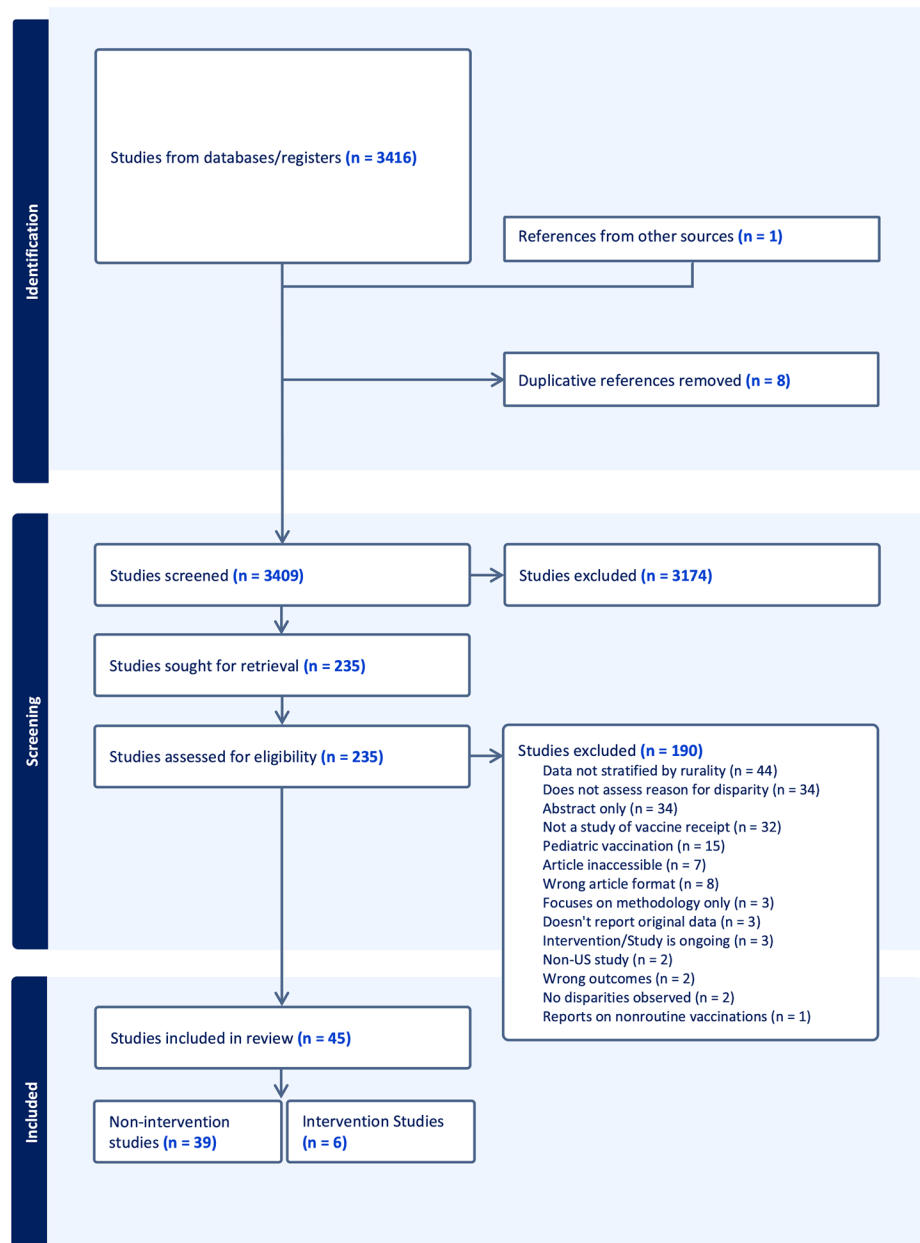


Fig. 1.
Flow chart of included and excluded observational and intervention studies.

Table 1
Descriptive table of included articles by COM-B level and vaccine of focus.

COM-B-level	COVID-19 vaccine	Influenza vaccine	HPV vaccine	Other/Multiple vaccines
1. Capability				
1.1 Physical	13, 14	16	15	
1.2 Psychological	54	50	12, 51	11
2. Opportunity				
2.1 Physical	13, 20, 22, 23, 29	18, 21, 24, 25, 26, 27	28	17, 19, 53
2.2 Social	20, 22, 23, 31, 41, 52		32, 33, 34	30
3. Motivation				
3.1 Reflective	13, 31, 35, 36, 38, 39, 41, 44, 46	25, 43	15, 34, 40, 42, 55	30, 45
3.2 Automatic	31, 35, 37, 39, 41, 47, 49	25, 48	34, 42, 55	

Table 2

Examining interventions designed to reduce vaccination coverage disparities between rural and urban adult populations.

Author, Year, Funding Source	Study design, Location/Setting, Timing	Population, Vaccine, Intervention	Comparison groups	Outcome, Results	Strengths	Weaknesses	Level of evidence quality
Johnson et al., 2003, Contract (500-96-P507) with the Centers for Medicare and Medicaid Services (CMS); Cooperative agreement (U32/CCU815663-02) with the Centers for Disease Control and Prevention (CDC), Division of Diabetes Translation	Nonrandomized experimental study. Montana, October and November 1999.	Adults ≥ 65 years of age and enrolled in Medicare ($n = 222$). Pneumococcal and Influenza vaccines. Implemented the following activities: (1) Community-wide education campaign including TV advertisements, posters, newspaper advertisements, and brochures. (2) Vaccination reminder mailers to counties receiving educational intervention and comparison areas.	Medicare beneficiaries receiving educational campaign materials vs. Medicare beneficiaries receiving mailed vaccine reminders only.	Vaccine awareness increased significantly in both groups ($p = 0.04$ and $p = 0.05$, respectively). Medicare claims for pneumococcal vaccination increased by 3.7 percentage points for beneficiaries receiving both educational campaign materials and mailed vaccine reminders. A 1.5 percentage point increase was observed for beneficiaries receiving mailed vaccine reminders only. Medicare beneficiaries receiving both the educational campaign and mailed vaccine reminders were more likely to have a claim for pneumococcal vaccination as compared to beneficiaries receiving mailed reminders only (OR 1.14, 95 % CI 1.07, 1.22).	Used two methods to evaluate efforts including, random digit dial telephone survey and examination of Medicare administrative claims.	Small sample size. Low response rate to survey (55 % for both groups). Adjustment for potential confounders not described. Findings for Influenza vaccine not presented. No comparison group was used to assess the effect of having no education campaign or reminder intervention. Self-reported receipt of vaccination. Recall bias for media intervention received and awareness of vaccination.	II-1, poor
Misra et al., 2024 Grant from West VA Department of Health and Human Services	Post-only quasi-experimental design. West Virginia, November 2022 to October 2023.	Adults ≥ 18 years of age with chronic disease diagnosis ($n = 1368$). COVID-19 vaccine. Implemented the following activities: (1) Standardized scripts and discussion flow charts for health navigators. (2) Short educational videos. (3) Patient assessment for chronic conditions and vaccination status.	None.	Individuals with lower education and income had significantly higher COVID-19 vaccine hesitancy ($p = 0.005$). The most frequently selected COVID-19 videos focused on the COVID-19 vaccine development timeline (22.4 %), safety (22.3 %), and long-term side effects (16.8 %). Participants with higher concerns were more likely to be unvaccinated and not complete their primary series or boosters ($p < 0.001$). Among participants who were either unvaccinated or did not complete their primary vaccine series, the education intervention increased their willingness to receive the COVID-19 vaccine by 11.4 %.	Large sample size. Intervention materials developed via Community Advisory Board representative of researchers, clinicians, and community members. Informed by the Exploration, Preparation, Implementation, and Sustainment (EPIS) Framework.	All participants were shown short educational videos, therefore no control group was available to assess the effect of the intervention. No adjustment for potential confounders. Social desirability bias because the survey was completed in the presence of a health navigator.	II-2, poor
Panagides et al., 2023 Funding not specified	Pre/post design. Virginia, October 2016 to September 2019.	Students ≥ 18 years of age attending various academic institutions ($n = 149$). Human Papilloma Virus	Pre-survey vs post-survey.	Significant changes were observed by rurality for 2 knowledge questions regarding HPV disease transmission and prevention. Similar results were observed for 3 attitudinal	Intervention informed by Health Belief Model (HBM); tested the efficacy of existing educational	Small sample size. Analysis of pre- and post-surveys vs pre-post pairs. Did not control for potential	II-3, poor

Author, Year, Funding Source	Study design, Location/Setting, Timing	Population, Vaccine, Intervention	Comparison groups	Outcome, Results	Strengths	Weaknesses	Level of evidence quality
Van Amburgh et al., 2001 Intramural research grant from Albany College of Pharmacy	Unblinded, single intervention. New York State. November 1999.	vaccine. Implemented Community screening of the educational documentary. All patients ≥65 years of age presenting to rural primary care clinic (n = 657). Influenza vaccine. Implemented the following activities: (1) Chart review to identify high-risk patients. (2) Influenza educational packet mailers. (3) Nurse telephone line to answer patient questions. (4) Vaccine provision.	Patient vaccination rates at baseline (1998) vs. patient vaccination rates post-intervention (1999).	questions regarding HPV vaccine safety perceptions, importance, and talking to a primary care provider about vaccination ($p < 0.05$). Among rural participants only, one knowledge question regarding types of cancers associated with HPV and two attitudinal questions regarding vaccine safety and talking with primary care providers about vaccination were significantly different pre- and post-documentary screening ($p < 0.05$). A significant increase in vaccination coverage was observed for all patients excluding those aged 65 years or older with no other indication for vaccination (28 % at baseline and 54 % post-intervention, $p < 0.05$). Intervention materials (educational packet and mailer) and healthcare provider recommendations were identified as the top reasons for patients choosing to get vaccinated. Additional patient suggestions for improvement include offering more days and times to get vaccinated and increasing the number of available providers. Reasons for patients choosing not to get vaccinated include believing the vaccine was not necessary, appointment scheduling conflicts or the patient forgot.	documentary. Addressed gap in the literature assessing the efficacy of community-based interventions in rural vs urban locations. Sub-analysis of rural vs urban differences and within rural differences.	confounders. Intervention focused solely on the female narrative and thus did not include information specific to the at-risk male population.	II-2, fair
Vanderpool et al., 2013 Cooperative agreement 1U48DP001932-01 from the Centers for Disease Control and Prevention	Randomized, control trial. Kentucky. 2010 to 2011.	Female adults ≥18 years of age attending study-sponsored vaccination events ($n = 344$). Human Papilloma Virus vaccine. Implemented the following activities: (1) Provision of first dose of vaccine at no cost. (2) Patient screening of educational DVD.	Patients who were asked to watch an educational DVD ("1-2-3 Pap") and received standard of care vs. patients who received standard of care (educational pamphlet) only.	HPV vaccine series completion was higher in the intervention group than in patients who received standard of care only (43.3 % vs 31.9 %, $p = 0.03$). Positive intent ($p = 0.16$) and belief that vaccination will reduce individual risk of developing cervical cancer ($p = 0.001$) significantly predicted completion of the HPV vaccine series. Female patients receiving the DVD intervention were significantly more likely to complete the HPV vaccine series (AOR 2.44, $p = 0.001$).	Intervention informed by theory of planned behavior (TPB); tested the efficacy of a field-based communication intervention. Multiple sites. Investigators and nurses blinded to participant allocation sequence. Loss to follow-up was minimal. Controlled for potential confounders in multivariate regression analysis.	Small sample size. Use of community-based sample (vs probability sampling).	I, good
Yang et al., 2023 Prevention Research Center grant from the Centers for	Double-control randomized trial. National. Spring 2022.	National sample of adults ≥18 years of age ($n = 1364$). COVID-19 vaccine. Implemented a	Health provider PSA vs Community leader PSA vs	PSA's featuring testimonials from clinicians were more successful in increasing intentions to receive the primary COVID-19 vaccine series than	Large sample size. Loss to follow-up was minimal for all allocation	Approach did not allow for investigators to	I, good

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Author, Year, Funding Source	Study design, Location/Setting, Timing	Population, Vaccine, Intervention	Comparison groups	Outcome, Results	Strengths	Weaknesses	Level of evidence quality
Disease Control and Prevention; Grant from WT Alumni Research Foundation		social media campaign featuring community leaders or clinician testimonials.	Control PSA vs No PSA.	both control PSAs ($p = 0.015$ and $p = 0.010$, respectively). Clinician testimonials also increased intentions for social diffusion, specifically private sharing ($p = 0.022$), discussion ($p = 0.32$), and social intervention ($p = 0.011$). These effects were not significantly moderated by political ideology, gender, age, education, race, or ethnicity.	groups. Present unconditional and conditional models with covariates. Conducted manipulation check to assess recognition of a) personal testimonials and b) message sources.	assess timeframe of vaccine behaviors.	