A Scoping Review of COVID-19 and Other Vaccination Models for Refugees and Migrants

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Abstract

Background: Refugees and migrants face inequities in healthcare and vaccination access. Diverse vaccination programs have been implemented globally to address refugee specific COVID-19 inequities to access, hesitancy and barriers to vaccination. The aim of this scoping review was to review evidence on the models of delivery of COVID-19 and other vaccinations for refugee and migrant populations.

Methods: A scoping review was conducted according to PRISMA guidelines. Eleven electronic databases including SCOPUS, Embase, Medline, and Web of Science as well as grey literature were searched with the keywords COVID-19, vaccines/immunizations, refugees, asylum seekers, and immigrants for all studies published between the years 2000 to October 2023. The main outcome was models of delivery of COVID-19 vaccines or other vaccines for refugee or migrant populations. Models of delivery were reviewed and thematically analyzed using the World Health Organization's 2022 operational guide, *Strengthening COVID-19 vaccine demand and uptake in refugees and migrants*.

Results: A total of n=11,825 unique studies were identified through database searches. A total of thirty-three (n=33) studies met full-text inclusion criteria and were included in this review. Fifteen studies (n=15) focused on the COVID-19 vaccine, while other studies (n=18) focused on influenza (n=6), HPV (n=2), Hepatitis B (n=2), multiple vaccines (n=5), and polio, cholera, and meningococcal vaccinations (n=3). COVID-19 vaccine models of delivery often utilized innovative social media strategies and relied on frameworks to drive interventions. Furthermore, models of vaccine delivery included multiple components which leveraged community and multi-stakeholder partnerships and co-design strategies, while striving to deliver culturally-sensitive approaches with accessible vaccination services.

Conclusions: Models of vaccine delivery for refugees and migrants are multipronged, utilizing various strategies and extensive community and multisectoral collaborations to address accessibility barriers in alignment with most WHO recommendations for vaccinating refugee and migrant populations. An increasing reliance on innovative social media, co-design, and customization strategies drives interventions. Further collection and use of disaggregated real-time data to inform and evaluate customized strategies for specific migrant groups is recommended.

Background

Globally, refugees and migrants face unique barriers and inequities to healthcare and vaccination access (1, 2). Refugees and migrants are generally under-immunized for routine vaccinations with higher rates of vaccine-preventable diseases (VPD) compared to non-migrant populations (3–5).

Despite efforts to target vaccination of refugees and migrants to achieve equitable outcomes, the extent of under-immunization of refugee and migrant populations is poorly defined (4, 5). Complex and contextual factors influence vaccination (4, 5). Refugees and migrants face several socioeconomic and educational barriers when accessing healthcare and immunization services compared to the host population (6), difficulties navigating the healthcare system (4, 5, 7), distrust of institutions, health systems, and authorities (4, 8), and discrimination and social exclusion (4, 5, 7) which impact vaccine access and uptake. Furthermore, refugees and migrants experience language and communication challenges (5, 7–9), and may have cultural and religious beliefs that impede vaccine acceptance (8).

During the pandemic, social and health vulnerabilities of refugees and migrants were further exacerbated through restrictions such as quarantine measures, travel bans, and interruptions to routine healthcare services and vaccinations (1, 2, 10–14). Multiple contributing factors led to higher COVID-19 infection rates at reception and accommodation centers for asylum seekers (2, 12), and increased COVID-19 infections in refugee and immigrant populations in Canada along with lower vaccination rates (15). Barriers to COVID-19 vaccination including hesitancy in accepting the novel vaccines as well as facing multiple legal, financial, administrative, language, and cultural barriers (3–7, 13, 16).

Many jurisdictions and authorities identified that high risk and excluded groups should be prioritized for equitable allocation of COVID-19 vaccines to uphold principles of equity in worldwide vaccine delivery (4, 17). It has also been recognized that innovative strategies of vaccine delivery are needed to address the diverse needs of hard-to-reach populations and migrants worldwide and to ensure equitable vaccine access and uptake (4–6, 16–19). Given the low rates of vaccination and unique barriers to vaccine uptake, effective models of delivery are needed to increase COVID-19 vaccine access and uptake among refugees and migrants.

While high level guidelines provide general direction on best practice for vaccine delivery for refugees and migrants, specific on-the-ground strategies for COVID-19 vaccines for refugees and migrants are not well understood. Numerous barriers to COVID-19 vaccine delivery and uptake must be addressed, such as vaccine hesitancy, misinformation, wide-ranging restrictions and lockdowns, and reduced access to services and healthcare. There are gaps in knowledge regarding how models of vaccine delivery have adapted to vulnerable groups worldwide in the context of the COVID-19 pandemic. This review addresses those gaps by examining specific models of COVID-19 and non-COVID-19 vaccine delivery for refugees and migrants, and draws out specific recommendations and best practices.

Methods

A scoping review was conducted to review evidence on the models of delivery of COVID-19 and other vaccinations for refugee and migrant populations according to PRISMA Extension for Scoping Reviews (PRISMA-ScR) Reporting guidelines (20).

Search Strategy

A search strategy protocol was developed with searches conducted in multiple databases including Medline, OVID Healthstar, Embase, Web of Science, Scopus, CINAHL, Academic Search Complete, Google scholar, Social Work Abstracts, and JSTOR within the publication years of January 2000 to May 2022.

An updated search was repeated in October 2023 to include June 2022 to October 2023 publications using the same search strategy protocol. The search terms included 'immunization', 'COVID-19', 'vaccine', 'refugees', 'asylum seekers', 'newcomers', and 'immigrants'. The search strategy was designed in consultation with an experienced Librarian (CM) using the PICOS (population, intervention, comparison, outcome, study design) framework (Additional file 1). The search strategy included a combination of free text keywords, controlled vocabulary and subject headings, where applicable (Additional file 2).

All citations were downloaded and duplicates were removed utilizing the systematic review software Covidence (www.covidence.org). Authors also screened reference lists of review articles identified through the initial search and those of selected primary papers to identify relevant studies not captured in our search.

Gray Literature

A gray literature search was conducted to explore non-academic literature between November 2021 and May 2022 using a combination of keywords including 'COVID vaccine', 'refugees', 'newcomers', and 'immigrants'. Google's site search feature was used to seek results specific to one institution. Non-governmental organization (NGO) and intergovernmental organization (IGO) search engines were used to find results specific to those organizations, as well as searching of sites including the World Health Organization (WHO) COVID-19 database, CADTH COVID-19 Evidence Portal, National Collaborating Centre for Methods and Tools COVID-19 Rapid Evidence Reviews, Health Canada, Centers for Disease Control and Prevention (CDC), and United Nations (UN) resources (Additional file 2).

Inclusion and Exclusion Criteria

Studies were included if they were published in English or French, if the target population included migrants/refugees/immigrants/asylum seekers (Additional file 3), if the intervention consisted of a model of delivery or intervention related to the delivery of vaccines to the target population, and if there was an evaluation component. Models of delivery for non-COVID-19 vaccinations were included to better understand the established models of delivery for refugee and migrant populations and parallel trends with the COVID-19 vaccine. The study population inclusion was broad to include vulnerable groups capturing various migrant groups. Study types included peer-reviewed quantitative, qualitative, and all study designs. Studies were excluded if they did not have evaluations to ensure reviewed policies were effective. Other exclusions included policy analyses, commentaries, editorials, reviews, or studies focusing on assessing population immunity/antibodies or travel vaccines.

Screening and Extraction

Titles and abstracts were independently screened by two authors (AP and LW; DG and LW) and conflicts were reviewed by a third author (FA or AN). Full-texts were each screened by two authors for eligibility (team of reviewers: DG, HK, AN; LW; DG, LW (French language)), and if conflict arose a third reviewer reviewed each study for eligibility (FA, AN, LW). The team conducted interrater tests prior to each screening stage and met at regular intervals during the screening process to ensure screening was based on shared understanding and application of inclusion and exclusion criteria. A PRISMA flow diagram (Fig. 1) was used to track screening and eligibility of studies (21, 22).

Data extraction of included articles was conducted by two reviewers (DG, HK) independently. The following categories of information were extracted from included articles: study author, title of article, host country (of research studies), characteristics of populations studied, study design, sample size (if applicable), vaccine type, models of delivery (type of intervention, location, registration and documentation process, agency overseeing intervention/implementation), results, and conclusion.

Data synthesis and analysis

Extracted data was tabulated, cleaned, and reported in Tables 1 and 2. Descriptive study data was synthesized using summary statistics (Table 1), models of vaccine delivery were summarized qualitatively (Table 2) and analyzed with the WHO's *Strengthening COVID-19 vaccine demand and uptake in refugees and migrants guide* (23) checklist of priority actions (Table 3). The WHO guideline was selected given the global health reach of the WHO and its specific focus on the operationalization of COVID-19 immunization for refugees and migrants (23). Two authors (DG, HK) independently reviewed extracted models of delivery information according to the following WHO (23) priority actions: (i) were driven by data, (ii) had coordination, planning and implementation, (iii) addressed key barriers to health and vaccination systems, (iv) ensured effective communication and built trust, (v) monitored and responded to social media, (vi) ensured effective community engagement, (vii) reinforced capacity and local solutions and, (viii) if there was monitoring, learning and evaluation (Table 3; Additional file 4). Strategies and activities of individual studies were extracted and thematized according to their fit with the eight priority actions. Following thematization, results were synthesized and analyzed to draw out insights such as strengths, common practices, and gaps. The two authors met throughout this process to ensure a shared understanding of how to conceptualize the eight WHO categories, how to match specific actions and activities to WHO categories, and discuss insights related to strengths, patterns, and gaps. Adherence of each study to each priority action area and a synthesis of the model of delivery themes are presented in Tables 3 & 4, with analysis data available in Additional file 4.

Table 1
Descriptive and demographic data of included studies (n = 33).

Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Alcendor et al., 2022 (25)	USA (Tennessee)	Black (majority), Hispanic, Asian, Native American, Pacific Islanders, White (underserved and minority rural/urban communities including individuals in public housing, faith communities, assisted living/elder care facilities, workplaces, homeless/unsheltered individuals, and immigrants)	Age (range): < 16: 141 16–29: 1395 30–49: 1742 50–64: 1085 65+: 532 Gender: n/a	4895	Mar 2021-Sept 2021	Non-randomized, quantitative	COVID-19 (Pfizer, Moc Johnson & Johnson)
Bentivegna et al., 2022 (33)	Italy (Rome)	Sub-Saharan African, North African (majority African), Asian, Middle Eastern (underserved/minority communities including informal settlement dwellers, homeless, migrants, refugees, asylum seekers)	Age (median): 24.9 (Tiburtina Station); 38.7 (Termini Station); 40.17 (Collatina Factory) Gender: Female: 18 (11.2%), Male: 142 (88.8%)	160	Jun 2021-Sept 2021	Observational, descriptive, qualitative/quantitative	COVID-19
Berrou et al., 2022 (36)	England	n/a (underserved/minority communities including non-English minority ethnic groups including refugees and asylum seekers (majority), homeless, Roma/travelers/boat people, and persons with learning difficulties, serious mental illness, drug and alcohol dependence, physical and sensory impairment, and dementia)	n/a	7979	Feb 2021-Aug 2021	Cohort study, retrospective descriptive, qualitative/quantitative	COVID-19
Desens et al., 2023 (26)	USA (California; Florida)	Black (Haitian, English-speaking Caribbean, southern Black), Hispanic, Punjabi, Hmong (underserved/minority communities including rural/farmworkers and migrants)	Age (range): 5–11 (Central Valley); n/a (Miami Dude)	n/a (county-wide populations)	May 2021-Dec 2021 (Miami-Dade, Florida); Feb 2022-June 2022 (Central Valley, California)	Observational, descriptive, case study, quantitative/qualitative	COVID-19 (Pfizer, Moderna)

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Elmore et al., 2022 (27)	USA (Virginia)	Multiple ethnicities from over 20 countries with most common languages being Dari, Arabic and Nepali and countries of origin including Afghanistan, Bhutan/Nepal, Iraq, Democratic Republic of Congo, Syria, and Other. (refugees)	Age (mean): 36.5 (SD = 16.4) Age (range): 12–15:112 (8%) 16 and over: 1215 (92%) Gender: Female 728 (55%), Male 594 (45%)	1,327	Dec 2020-May 2021 (campaign); Mar 2021-Feb 2022 (outcomes)	Non-randomized, quantitative/qualitative	COVID-19 (Moderna, F Johnson & Johnson)
Holdbrook et al., 2023 (37)	Canada (Alberta)	n/a (underserved/minority communities, self-identified racialized communities & migrants)	Age (range) (stakeholders only): < 18: 1 20–29: 9 30–39: 38 40–49: 49 50–59: 28 60–69: 11 Gender (stakeholders only): Female: 91 (66.4%), Male: 46 (33.6%)	141 (stakeholders only)	Jun 5–6, 2023 (formative evaluation)	Observational, qualitative	COVID-19

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Lohr et al., 2023 (28)	USA (Minnesota)	Hispanic/Latino (65%); Other (unspecified) (migrants inclusive of immigrants, refugees, and asylum seekers)	Age (mean): 40 (SD = 14) Age (range): 5–11: 176 (15%) 12–17: 119 (10%) 18+: 847 (73%) Age (mean) (survey only): 43 (SD = 10). Gender: Female 527 (46%), Male 584 (50%) Gender (survey only): Female: 30 (86%), Male: 5 (14%)	985 (vaccination)/ 37 (survey)	Mar 27 2021-Dec 11, 2021	Non-randomized, quantitative	COVID-19
Malone et al., 2022 (29)	USA (Georgia)	Black, White, Asian, Hispanic, Latino (immigrants & refugees)	n/a	3127	Jan 2021-May 28 2021	Non-randomized, quantitative	COVID-19 (Pfizer, Moderna)
Morisod et al., 2023 (38)	Switzerland (Canton of Vaud)	Individuals from 97 nationalities (migrants including undocumented migrants)	Age (mean): 38 Gender: Female: 48%	2351	26 May 2021-25 Oct 2021	Non-randomized, quantitative	COVID-19 (Spikevax)
Marquez et al., 2021 (30)	USA (California)	Latinx (majority, 70.5%), White (14.1%), Asian (7.7%), Black (2.4%), Other (5.3%) (immigrants of first generation and underserved/minority communities)	Age (median): 43 (IQR 32–56) Age (range): 16–30: 2530 (22.8%), 31–50:4658 (42.0%), 50–64: 2617 (23.6%), 65+: 1293 (11.7%) Gender: Male: 5978 (53.9%) Female: 4926 (44.4%), Non-binary/other: 194 (1.7%)	11098	Feb 2021 - May 19, 2021	Non-randomized, quantitative/qualitative	COVID-19 (Pfizer, Moderna)

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Nair et al., 2022 (39)	USA & Canada	Malayalam (majority) (immigrants)	Age (range): 18–30: 9, 31–50: 59, 51–65: 21, > 65: 2. Gender: Female: 33 Male: 58	92	2020–2021	Non-randomized, quantitative	COVID-19
Noack, Schaning, & Muller, 2022 (34)	Germany (Leipzig, Saxony)	Languages targeted Arabic, Romanian, Spanish (Latin American Spanish), Vietnamese, Albanian, English, Thai, Polish, Slovak, and Russian. (migrants)	Age (range) (pilot study only): 41–65: 11 18–40: 8 Gender (pilot study only): Female: 8 Male: 12	20	2021	Non-randomized, pilot study, qualitative/quantitative	COVID-19 (Pfizer, Moc AstraZenec Johnson & Johnson (a content); Comirnaty BioNTech/F Spikevax Moderna (p study)
Rosales et al., 2023 (31)	USA	Latinx (immigrants and underserved/minority communities including rural communities)	n/a	245541 (all services); 31000 (COVID-19 vaccines)	Feb 2021-Sept 2021	Non-randomized/observational, qualitative/quantitative	COVID-19 a other vacci
Shah et al., 2023 (32)	USA (Maryland)	Latino (immigrants)	n/a	424 (survey respondents) (305 122 reached through social media advertisements, 9607 web site visitors)	Mar 1, 2021-Mar 1, 2022	Non-randomized, quantitative	COVID-19
Tjaden, Haarmann, & Savaskan, 2023 (35)	Germany	Arabic, Turkish, Russian speakers (migrants)	n/a	888994	Nov 25, 2021-Dec 23, 2021 (Berlin); Dec 7 - Dec 23 2–21 (Germany)	Randomized controlled trial, quantitative	COVID-19
Other Vaccines							
Amani et al., 2021 (40)	Cameroon	From neighboring countries to Cameroon (mainly Central African Republic, Nigeria and Chad) (refugees in camp)	Age (range): >2	191652	Jul 2020-Sep 2020	Observational, quantitative, cross-sectional	Meningoco Meningitis, Y, W (Mena

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Aragones et al., 2015 (41)	USA (New York)	Mexican (Immigrant [i.e. parents])	Age (mean) (parents only): 37 Age (range) (parents only): > 18 Gender: Female (parents only): 78%	69 (parents only)	2012–2013	Non-randomized, pilot, quantitative	HPV
Brown et al., 2021 (42)	USA (Tennessee)	White 23.1%, Black/African American 12.3%, American Indian 0.7%, Asian/Pacific Islander 12.9%, Middle Eastern 15.9%, Other 1.1%, Missing 33.9%. (underserved/minority communities including homeless, low-income populations, immigrants, and refugees)	Age (mean): 40.8 Age (range): >8 Gender: Female:844 (48.7%), Male: 856 (49.4%), Missing: 33 (1.9%).	1733	2015–2019	Non-randomized, quantitative	Influenza
Chu et al., 2021 (43)	USA	East African (Somalia (80.7%), Ethiopia (16.7%), Eritrea (2.6%)) (immigrants)	Age (range) (mothers): < 30: 3, 30–39: 65, 40–49: 38, 50+: 8. Gender (mothers): Female: 114 (100%)	115 (mothers)	Oct 2017 - Sep 2018	Non-randomized, quantitative	HPV

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Coady et al., 2008 (44)	USA (NYC)	Hispanic (72%) (underserved/minority communities including hard-to-reach populations in urban neighbourhoods including substance users, immigrants, elderly, sex workers, homeless persons)	Age (mean): 41 Gender: Female: 60%	6826	Jan 2005 - Mar 2005; Sep 2005 - Oct 2005	Non-randomized, quantitative	Influenza
Harvey et al., 2022 (45)	Kenya	Somali (migrant children)	Age (range): 0–59 months	2524 (measles vaccine)/2196 (polio vaccine)	Apr 2019 – May 2019	Non-randomized, qualitative/quantitative	Polio (biva OPV- types and 3), Mea
Hoppe & Eckert, 2011 (46)	USA (Washington)	West/East African (45%), African American (24%), Caucasian (12%), Hispanic (10%), Pacific Islander/Asian (6%), Native American (1%). (immigrant obstetric patients)	Age (mean): 27.8 Gender: Female: 100%	157	2009	Non-randomized, retrospective, quantitative	Influenza (H1N1)
Kong et al., 2020 (47)	Australia	n/a (underserved/minority communities including hard-to-reach populations such as homeless, including refugees and migrants (34%))	Age (range): 65+: 102 (10%) < 18: 12% < 5: 65 (6%)	1069 (vaccines)/1032 (surveys)	Apr 2018 - Oct 2018 (survey)	Non-randomized, quantitative	Influenza
McPhee et al., 2003 (49)	USA (Houston, Texas)	Vietnamese/Vietnamese-American (immigrant children)	Age (mean) (parents): 42.5 Age (range): 3–18 (children) 18–79 (parents)	1508 preintervention; 1547 post intervention (parents)	Apr 1998 - Mar 2000	Randomized, quantitative	HepB
Mellou et al., 2019 (50)	Greece	Syria (42.0%); Iraq (28.2%); Afghanistan (19.8%); Other (9.9%); Unknown (0.1%); (19 different nationalities recorded for the 375 children in the category of 'Other') (refugee and migrant children in camps and community)	Age (range): < 1: 285 (7.5%) 1–4: 1,224 (32.3%) 5–14: 2,277 (60.2%) Gender: Female: 1,720 (45.4%) Male: 2,002 (52.9%) Unknown: 64 (1.7%)	3786 (children in camps)	Apr 2017-Apr 2018	Non-randomized, quantitative	MMR, diphtheria-tetanus-pertussis (D poliomyeliti pneumococ Haemophilu influenzae t b, HepB

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Milne et al., 2006 (51)	Australia (Western Sydney)	From 32 countries speaking 35 languages (Asian (41%); Middle Eastern (26%), African (10%), European (10%), English (5%), Unknown (5%), Other (2%), Pacific (1%)) (refugee and migrant student children & youth)	Age (mean): 15 Age (range): 10–23 Gender: Female: 65 (39%) Male: 96 (58%) Unknown: 4 (2%)	165	Jun 2003 (survey)	Non-randomized, quantitative	MMR, HepB
Mitchell et al., 2021 (52)	Thailand, Nepal, Kenya, Ethiopia, Malaysia, and Uganda (Phase I); over 50 countries in Africa, Asia, Europe, Middle East, Americas	Africa, Asia, Europe, Middle East, Americas (refugees)	All ages	320000	Dec 2012-Sep 2019	Case study, quantitative/qualitative	DTP or Dtal Hep B, Hib+ MMR, bOPV IPV, Pneumococ conjugate, Rotavirus, T Tdap, Men-ACWY conjugate+, Varicella, Influenza

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Peterson et al., 2019 (53)	USA (Minnesota)	Hispanic/Latino (35.4%), Asian/Pacific Islander (29.7%), Non-Hispanic white (9.8%), Not specified (13.9%), African American (6.2%), African-born (3.3%), Multiracial (1.0%), American Indian (0.7%). (immigrants and underserved/minority communities including racial/ethnic minority)	Age (range): 0–5: 242 (4.1%), 6–9: 486 (8.2%), 10–18: 1091 (18.5%), 19–44: 2107 (35.7%), 45–64: 1370 (23.2%), 65–74: (5.2%), 75+: (1.9%), Not specified: (3.3%) Gender: Female: 3049 (51.6%) Male: 2505 (42.4%) Other: 4 (0.1%) Not specified: 352 (6.0%)	5910	Oct 2017-Jan 2018	Non-randomized, case study, qualitative/quantitative	Influenza
Phares et al., 2016 (54)	Thailand	Karen (~ 75%) (refugees in camp)	Age (range): 1 or over Gender: Male: 22,758 (50%**) (**from the census of the whole camp of 45,524 refugees)	43485	2013	Non-randomized, case study, quantitative	Cholera (ora two-dose)
Pollack et al., 2011 (55)	USA (New York)	Asian (majority), American/ Pacific Islanders, African, Carribean, Central/South American (immigrants)	Age (range): <20: (3.4%), 20–39: (37.6%), 40–59: (44%), > 59: (14.8%)	8888	Mar 2004 - Jun 2008	Non-randomized, descriptive, pilot, quantitative	HepB
Ponce-Gonzalez et al., 2021 (56)	USA (Washington)	Latinx (migrants & refugees)	Age (range): < 30: 23.9% 30–39: 27.1% 40–49: 29% 50+: 20%	183	Jan 2021; May 2021	Non-randomized, quantitative	Influenza

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Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Sheikh et al., 2014 (48)	Kenya	Somali (refugees in refugee camps and host communities)	Age (range, in months): 0–59	126000	Dec 2013	Non-randomized, descriptive, quantitative	Polio (IPV, C
Vita et al., 2019 (57)	Italy (Castelnuovo di Porto)	African (90%) (majority Sub-Saharan African) Asian (10%) (migrants)	Age (median): 5 (minors) Age (range): < 18: 95% 18+: 85% Gender: Female: 236 (6%)	3941	Apr 2013-Mar 2017	Cross-sectional, quantitative	Ddiphtheria tetanus, pertussis, H poliomyeliti (inactivatec IPV), Haemophilu influenzae t b (Hib), (combinatic Infanrix Hex Hexyon, Tetravac. Tetraxim, PolioBoostr MMR & Var (Priorix Tetr ProQuad), pneumococ (Prevenar13 meningoco C (Menjuga Meningitec) HepB (Enge B), poliomy (Imovax Po HPV (Garda Varicella zo virus (Variv Varilrix)

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Table 2
Summary of models of vaccine delivery of included studies (n = 33).

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Alcendor et al., 2022 (25)	Meharry Medical College COVID-19 mobile vaccine program (MMC-MVP) with free mobile vaccination outreach unit that travels to pre-arranged vaccine events in targeted areas providing education and delivering vaccines *Notable features*: •Collaboration with Hispanic/Latinx and immigrant community-based organizations for culturally-appropriate information provision. •Supported by disease experts, nurse practitioners, and community engagement personnel. •Multi-lingual flyers, infographics, Facebook Live sessions, on-site translators, bilingual medical staff.	Community venues in underserved urban/rural settings.	Vaccination status assessed and vaccination proposed at prescheduled vaccine events; database used for registration, vaccination card and information about second dose provided.	Meharry Medical College; Tennessee Community Engagement Alliance; Vanderbilt University School of Nursing; Bloomberg Foundation; COVID-19 vaccine strike teams; community-based/faith-based organizations.	•Vaccinated 4895 participants
Bentivegna et al., 2022 (33)	Vaccination campaign according to the *Framework for Equitable Allocation of COVID-19 Vaccine* with communication dissemination and vaccination delivery as part of free weekly health visits via mobile outreach to informal settlements: *Notable features*: •Long-standing collaborations with healthcare/social support services, inhabitants, and local committee (internal organizing committee with key authoritative figures in settlement). •Information leaflets distributed in informal settlements designed in collaboration with other support associations and translated into 10 languages by mediators; 'information days' organized. •Weekly meetings gathering data to optimize vaccination campaign.	Vaccination centers.	n/a	MEDU "Doctors for Human Rights" non-profit association; support organizations (e.g, Medicins Sans Frontiers, Caritas, Medici del mondo, local health authority).	•Vaccination coverage in transiting and resident populations was significantly different. •greater reticence to vaccination of the sub-Saharan population and eastern Europeans.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Berrou et al., 2022 (36)	'Maximising Uptake Programme' consisting of two key interventions: 1) engagement and communication targeting misinformation, and 2) outreach with pop-up clinics and other outreach providing vaccine: *Notable features*: •Dedicated workgroup designed and coordinated program with tailored interventions to each target population group. •Co-designed with community leaders and influencers (i.e., 'community champions') with learnings from pilot pop-up influenza clinics and community feedback. •Group 2 (Migrant group): written materials/social media outputs in different languages delivered; local community influencers and healthcare professionals; community champions managed booking system; multilingual 'link workers'; streamlined services for asylum seekers/ refugees/undocumented migrants; focus groups/ informal conversations in community by trusted healthcare professionals. •Routinely collected quantitative and qualitative data by 'Insights and Engagement team'.	Group 2 (Migrants): "pop-up" clinics in community centres, mosques and gurdwaras and proximity to hotels, community centres, supermarkets, shops, parks, churches.	Bookings and appointments arranged by local community groups.	Maximizing Uptake Group (dedicated group within the regional Programme); Healthier Together partnership for Bristol, North Somerset and South Gloucestershire (BNSSG); community organizations.	• Vaccination of a total of 7979 high risk individuals through 162 outreach activities [Group 2: 7241 individuals; 93 outreach activities] •Qualitative results: use of community spaces effective; Eastern European community leaders difficult to identify with low engagement and higher vaccine hesitancy; examples of communication strategies provided.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Desens et al., 2023 (26)	Vaccination campaigns addressing vaccine hesitancy in two underserved communities with the application of the HIPE™ (Health Information Persuasion Exploration) Framework with the persuasion and behavioral change theory: *Notable features*: •Use of social media listening tool to report narratives of online misleading discourse and discourse analysis to inform the design of response and communication strategies customized to each subpopulation/language group, with a formative and impact evaluation. •Miami-Dade Campaign: mobile app for crowd-sourced reporting of social media and on-the-ground discourse by individuals recruited from local communities; development of social media communication; collaborated with churches and community (trusted messengers); regular webinar sessions/education at vaccination events. •Central Valley: partnered with trusted network of outreach workers (Promotoras, CHWs), door-to-door information dissemination; virtual messaging platform for reporting; partnership with schools; mobile vans for outreach; online message testing sessions.	•Miami Dade: churches in local communities; vaccine sites in local communities. •Central Valley: rural community sites (e.g. schools).	n/a	• Miami Dade: Florida International University (FIU); KTFF (Keeping the Faith to Fight). •Central Valley: Livingston Community Health (LCH) and Valley Onward; ACTIVATE (digital health collaboration).	•Both campaigns achieved their respective vaccine uptake goals. •Miami-Dade: over 850 vaccinations administered (goal was 800); vaccination rates increased by 25%. •Central Valley: vaccination rates for 5–11 year old children increased about 20% and 14%, respectively; overall vaccination rates increased compared to surrounding counties.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Elmore et al., 2022 (27)	Four-pronged strategy tailored to local refugees with vaccine appointments offered within the week at a mass vaccine clinic using a multisectoral partnership: *Notable features*: •1) phone calls offering vaccination with language interpreters, 2) follow-up contact by registered nurse-care coordinator if declined/no contact, 3) mass direct messaging via text messaging or emails in multiple languages on how to schedule vaccine, 4) neighborhood door-to-door outreach. •Health system, non-profit, and community stakeholders planned and tailored strategy to community needs and shared resources (e.g., interpreters/mobile language interpretation service, health equipment, mobile language interpretation service, vaccine call centre staff, health information system). •Transportation rides to clinic, extended hours of services, 'language blocks' to serve different ethnicities.	UVA vaccine clinic in retail space with parking close to IRC near neighborhoods with refugee families; outreach in seven specific neighbourhoods housing target population.	Door-to-door scheduling of appointments via tablets; flyers with scheduling information (i.e., via hotline); no cost and insurance/ID/immigration documentation required; appointments within week.	University of Virginia (UVA) Health; UVA International Family Medicine Clinic (IFMC); local resettlement office of the International Rescue Committee (IRC); Blue Ridge Health District (BRHD); non-profits and community leaders.	•895 (67.4%) had at least one dose; of 895 with first dose, 843 completed two-dose series (94.2%). •Overall completion rate of initial series: 63.5%. •Reasons for declining (171, 13%) included wanting to speak with a physician or family member first; pregnancy hesitation; postponing until after Ramadan.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Holdbrook et al., 2023 (37)	Outreach vaccination 'hockey hub' pop-up mobile clinic with multi-stakeholder collaboration in target community location: *Notable features*: •Co-designed and implemented by collaborative of stakeholders •Services in multiple languages with cultural brokers. •Free public transit to and from site; extended hours of operation; community agencies provided food hampers/social supports.	Pop-up mobile clinic in a large city-owned recreation center/arena.	•Free walk-up model, no appointments, open regardless of immigration status/documentation or health care coverage.	•CNC (Calgary East Zone Newcomers Collaborative) collective of immigrant services; community-based organizations; volunteers; healthcare workers; service providers supporting migrants and newcomers; municipal, provincial, federal governments.	•Respondents almost uniformly felt the vaccine clinic met its collaboratively defined goals •Patients reported near universal agreement that the clinic was convenient and safe •[2280 first dose COVID-19 vaccinations were delivered-reported elsewhere]

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COVID-19 Vaccine					
Lohr et al., 2023 (28)	Community-based vaccine clinics in target locations with community-engagement and bidirectional communication: *Notable features*: •Adopted CDC's Crisis and Emergency Risk Communication (CERC) framework and used Rothman's community intervention approaches for a community organization model. •Collaborated with multiple stakeholders to address population needs, promote clinics, adapt strategies, and volunteer at clinics. •Bidirectional communication between community and academic partners while informing regional decision makers. •COVID-19 Task Force formed communication working group and used a 7-step process to adapt and distribute COVID-19 messaging (i.e. developed message maps, recruited community-trusted communication leaders (CLs), messages adapted based on CL feedback and cultural appropriateness, distributed by CLs via virtual/social media platforms, bilingual staff systematically tracked/addressed concerns). •Communication in multiple languages and formats disseminated through social media and virtual messaging platforms.	Clinics at three elementary schools; community education center; non-profit that provides support services for im/ migrants.	Walk-ins but also had pre-registration; Staff and communication leaders pre-registered, sent reminders, followed-up on location and time for the second dose; flexibility in time and ease of registration.	Mayo Clinic COVID-19 Vaccine Allocation and Distribution Workgroup (COVAD); Rochester Healthy Community Partnership (RHCP); community-based COVID-19 Task Force; academic partners; public health department.	•Administered 1158 vaccines. •Participants viewed the intervention as acceptable; nearly all participants reported that the intervention convinced them to receive a COVID-19 vaccine.
Malone et al., 2022 (29)	Vaccination campaign in a target location at a community primary care clinic: *Notable features*: •Trusted relationships with culturally sensitive community partners. •Vaccination team with additional full-time staff hired and volunteers from a variety of racial/ethnic backgrounds and languages spoken. •Telephone translation services and information materials provided in multiple languages.	Community-based primary care clinic.	Community engagement coordinator and community partners assisted with registration and transportation.	Ethne Health (community-based primary care clinic); community partners/volunteers.	Partially or fully vaccinated 3127 individuals; 2692 were fully vaccinated

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Marquez et al., 2021 (30)	"Motivate, Vaccinate, and Activate" community vaccination strategy using the theory-informed PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) Model: *Notable features*: •Community-academic-public health partnership model. •Strategy targeted various barriers to vaccination (e.g. trusted Spanish-speaking community members conducted door-to-door outreach; survey on attitudes to vaccine; culturally-tailored site with bilingual staff; peer vaccine ambassadors; interviews on Spanish language radio shows; vaccine townhalls; information on social media; adapted in response to eligibility criteria changes and site capacity). •Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework (evaluation).	Neighborhood vaccination sites located outdoors, (e.g. parking lot across from free COVID-19 testing site at busy public plaza and transportation hub)	Low-barrier scheduling, registration/vaccination: on-site registration 7 days a week; walk-up appointments; no need to show ID, residency/health insurance status/vaccine eligibility; automatic scheduling for second dose.	"Unidos en Salud" Latinx support (inc. San Francisco Latino Task Force-Response to COVID-19 (LTF), University of California, Berkeley, the Chan Zuckerberg Biohub, Bay Area Phlebotomy & Laboratory Services (BayPLS), Primary Health, San Francisco Department of Public Health (SFDPH)	• 20,792 vaccinations to community members. •Program was highly Effective, 58% of clients reported they were vaccinated sooner because of the program. •Program had Fidelity: able to deliver each of the components strategy as originally intended. •Program was highly Acceptable, with 99% of clients reporting they would recommend site.
Morisod et al., 2023 (38)	Communication and vaccination campaign for undocumented migrants: *Notable features*: •Multilingual written material/questionnaire and interpreters. •Community partners had crucial role in promoting campaign; use of online social network groups with influential health care provider and members of community sending translated messages. •Multidisciplinary working group was formed including administrative, medical, nursing and pharmacy managers having expertise with migrant population. •System adapted to address administrative, language and cultural barriers. •Working group met weekly to monitor the project and make adaptations.	Regional center of general medicine and public health.	Low-barrier registration without health insurance or appointment needed to receive free vaccine; anonymous vaccination, extended opening hours; adapted administrative form to limit collection of personal information.	Cantonal health authorities; at least 50 community partners (e.g., migrant associations, churches, NGOs, etc.).	•2351 undocumented migrants without health insurance received at least one dose; 2164 (92%) received an appointment for a second dose (some participants had a history of COVID-19 and were considered fully vaccinated after one dose).
Nair et al., 2022 (39)	Short webinar conducted by an expert medical professional from target ethnic community explaining the efficacy and safety of the vaccine: *Notable features*: •Use of virtual platform to interact with participants directly and clarify vaccine questions. •Pre/post survey on confidence in receiving vaccine. •Recruited participants via social media.	Online webinar	n/a	n/a	•Participants reported greater confidence in receiving vaccine after webinar with statistically significant difference between pre- and post-webinar confidence scores.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Noack, Schaning, & Muller, 2022 (34)	Developed multilingual mobile application to assist healthcare providers to effectively deliver vaccines and user tested in a pilot with mobile outreach: *Notable features*: •Vaccination registration process, informed consent, medical history taking, and other vaccination content in 39 languages. •Spiral Technology Action Research (STAR) model to create app within a discursive process involving healthcare professionals (HCPs), literature/guidelines, field trials (e.g. listened to the target groups to determine needs; interviewed staff at vaccination centers).	Mobile vaccination outreach teams across 6 outreach deployments (user testing).	App supports registration process, informed consent, medical history taking.	aidminutes GmbH (German e-health service provider); the Robert Koch Institute (German National Institute for Public Health); German Federal Ministry of Health.	App demonstrated its usability and was well accepted by the vaccination candidates.
Rosales et al., 2023 (31)	Mobile Health and Wellness Project with education and vaccination services with a fleet of mobile health units: *Notable features*: •Counseling, basic health screenings, referrals, and vaccinations. •301 local alliances made (e.g., state and local health departments, community-based organizations, Consulates, other). •Three strategic initiatives: *Disseminate and adopt, Inform and adapt, and Target and train.* •Key activities: Latinx essential worker and community involvement; cultural and linguistically adapted printed educational materials; dissemination via social media/radio/television/community events (virtual and in-person)/Facebook live/open virtual forums/community health fairs and events; collected common myths and adapted information; medical professionals at events to answer questions; feedback sessions on best practices generated 24 best practices; recruited and trained community health workers, volunteers, and students; outreach, trust building, and personalized orientations; health promoters (i.e. *Promotoras*) had specialized training and support in self-care.	11 mobile health units (vehicles) in remote communities.	Free, and accessible regardless of insurance coverage or immigration status.	•US Centers for Disease Control and Prevention (CDC); United States-Mexico Border Health Commission; Latino Commission on AIDS (LCOA); Alianza Americas (AA); National Autonomous University of Mexico; community based organizations; health departments; community (Promotoras de salud, volunteers and students)	•54,625 vaccines given; 31,000 COVID-19 vaccines •1,535,771 services to 245,541 people •Dissemination of information on social networks (Facebook, Twitter, Instagram, and YouTube), yielded: reach-341,860; reactions-9,890; comments-3,089 and shares-1,741. •104,991 COVID-19 services provided •Outreach: 1,006,410 Television, 427,870 r radio.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Shah et al., 2023 (32)	'*Sin Duda'* community-engaged statewide social media marketing campaign targeting ethnic communities to access project web site with COVID-19 and community-based services information: *Notable features*: •Community-based participatory research approach guided by community advisory board at each stage. •Project website with bilingual information and option to request community health worker (CHW) navigation to COVID-19 services. •Information developed taking into account cultural beliefs from diverse countries of origin and input from Latino community/team members (advisory board, CHWs, media designers). •First developed accessible COVID-19 testing and vaccination services in partnership with local CBOs. •Paid advertisements on social media and unpaid advertisements on community organization social media and virtual platforms. •Reach assessed by online metrics and surveys conducted at 30 different community-based venues.	Virtual & community-based venues (e.g., churches, consulate, parks)	Free community-based events conducted twice a week; COVID-19 bilingual hotline. .	Local community-based organizations (CBOs).	•Reached 305 122 people through social media; 9607 visitors to the web site. •1075 web site requests for COVID-19 vaccinations •Facebook was the most common means of exposure (n = 5102; 84% of those exposed), WhatsApp (n = 564; 53%). •61% (n = 574) influenced their decision to get vaccinated
Tjaden, Haarmann, & Savaskan, 2023 (35)	Targeted, low-cost, social media campaign for target migrant groups: *Notable features*: •Social media campaign with multiple advertisements encouraging vaccination, providing information, with easy access in multiple languages to vaccination appointment booking tools (online, telephone, or local walk-in locations). •Social media users exposed to one of 36 advertisements using simple, double-blind randomization automatically assigned by Facebook advertisement manager platform to native or German language (language experiment), government, doctor, family, leader messenger types (messenger experiment). •Design informed by best practice and interviews with local stakeholders working with migrant communities •Aggregate data tracked automatically by Facebook with extrapolated estimated conversion rates.	Virtual (i.e. Facebook).	Link in online advertisement to vaccination appointment booking tool/website with information (in user language).	Stakeholders working with local migrant communities (i.e. public health agency, social worker providers, agency for intercultural communication).	•Reach: 890,00 Facebook users. Migrants were 2.4 (Arabic), 1.8 (Russian) and 1.2 (Turkish) times more likely to click on advertisements translated to their native language compared to German-language advertisements. •Arabic and Russian speakers were more likely to click on the advertisement depicting the government official.
Other vaccines					

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Amani et al., 2021 (40)	Preventive mass vaccination campaign in refugee camps (two rounds): *Notable features*: •Installation of fixed and temporary fixed posts. •Multiple levels of the Ministry of Health involved in planning and coordination; regional and district coordinating teams. •Advocacy, communication and social mobilization (e.g. training of media professionals, information posters in both national languages). •Training of health workers and volunteers.	Refugee camps in Cameroon: Far-North, East region and the Adamawa within the second round.	Data and immunization information filled on vaccination cards and recorded in campaign tally sheets.	Cameroon Ministry of Public; Technical and financial partners (WHO, UNICEF, AHA and UNHCR).	Global vaccination coverage of 101.62%
Aragones et al., 2015 (41)	Parental education and text messaging reminders: *Notable features*: •Parental education consisting of 20-min one-on-one educational sessions. •Text messages in Spanish once a week reminding of child's vaccination eligibility with reminders sent until uptake of the first dose of the vaccine was reported, or for 6 weeks after recruitment.	Health Window program at the Mexican Consulate in New York City.	Those who attended the Health Window were approached to assess eligibility; registered for vaccination independently.	Mexican Consulate in New York.	88% series completion rate in the children of those who received text messages.
Brown et al., 2021 (42)	Interprofessional student-run vaccine outreach program (VOP): *Notable features*: •Free vaccination events in nontraditional community locations. •Community partner involvement to advertise/schedule vaccines, train incoming coordinators, lead vaccination events, obtain necessary staff and supplies. •Interprofessional collaboration between nurse practitioner, medical, nursing, and pharmacy students. •One-on-one conversations at events to educate and register for vaccination; volunteers and interpreters/telephone-based medical interpreting services at events.	Various community venues (e.g. local clinic conducting community outreach in immigrant/refugee populations).	Individuals attending events were screened and vaccinated.	Vanderbilt University School of Medicine's (VUSM) student-run free clinic.	1,803 influenza vaccines were administered at outreach events.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Chu et al., 2021(43)	Culturally-appropriate interactive educational events delivered by co-ethnic healthcare professional with mothers: *Notable features*: •Culturally appropriate dinner events with 20-min educational presentation in native language including video testimonial from mother from community and 20-min question and answer period. •Multi-step process to develop intervention including review of research on barriers/facilitators and conducting focus groups, feedback from community partners, and materials reviewed by co-ethnic research team. •Community partners provided contacts of mothers who might be interested in participating.	Dinners in the Seattle metropolitan area (8 Somali community, 2 Ethiopian community).	Vaccination data from health information system (including dates and number of doses).	University research team.	•Post-intervention, marked improvements in HPV- and HPV-vaccine-related knowledge, beliefs and attitudes. •Pre-intervention, only 16% of mothers reported that they were somewhat or very likely to vaccinate their child, compared to 83% post-intervention.
Coady et al., 2008 (44)	Project VIVA (Venue-Intensive Vaccines for Adults), a multi-level community-based intervention with outreach and vaccine distribution activities targeting hard-to-reach populations at the individual, community organization, and neighborhood levels: *Notable features*: •Individual level: nurses and physicians delivered vaccinations. •Community organization level: presentations given to local community boards and organizations; vaccination. •Neighborhood level: informational flyers and pamphlets distributed in neighbourhoods. •Intervention working group met regularly throughout the project to guide project implementation and evaluation.	Door-to-door, on the street, at community based organizations; neighbourhoods (East Harlem/Bronx, NYC)	Offering vaccination in door-to-door and street-based settings.	Researchers; community members (intervention working group: community residents, community-based organizations (CBOs), academic institutions, local health department)	•Interest in vaccination significantly increased. •566 vaccines were administered door-to-door in 4 neighborhood Areas.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Harvey et al., 2022(45)	Targeted vaccination campaign using key migration routes of mobile population: *Notable features*: •Vaccination sites selected based on findings from focus groups with local ethnic community members regarding migration routes using qualitative and geospatial data with a participatory mapping technique. •Static teams at major crossing routes and border villages. •Community mobilizers and other leaders provided mass awareness sessions. •Concurrently provided nutritional support, vit A, albendazole •Engagement of international humanitarian organizations with department of health to ensure alignment of immunization service delivery.	•29 sites with active migrant presence.	n/a	International Organization of Migration (IOM); American Refugee Committee (ARC); Garissa County's Department of Health.	•Administered 2196 doses of bOPV and 2524 doses of measles vaccine to children.
Hoppe & Eckert, 2011(46)	Multifaceted intervention to increase vaccination in target obstetrics population with adapted clinical processes and educational sessions: *Notable features*: •Education video in waiting room in 9 languages and printed educational material. •Planned future obstetrical visits within 2 wks of anticipated vaccine. •Contacted patients personally in own language; medical interpreters invited; use of cultural case workers. •Taxi transportation. •Educational sessions for team members. •Created a real-time vaccine registry with electronic schedule prompts.	Women's Clinic, Harborview Medical Center (HMC), Seattle, Washington (serves an ethnically diverse population)	•During obstetrical visits all pregnant patients enrolled at clinic at the time the vaccine became available, accessed via electronic vaccine registry.	Department of Obstetrics and Gynecology, Harborview Medical Center (clinical site for the University of Washington School of Medicine).	•Within the first month of H1N1 availability, 120 of total 157 obstetrics patients were vaccinated. •Overall coverage rate was 76%

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Kong et al, 2020(47)	Mobile outreach influenza immunisation program ('VaxReach') for vulnerable populations in a resource-rich setting: *Notable features*: •Teams of nurse immunisers visited and provided vaccines to clients at multiple sites. •Key stakeholders met and discussed priority populations and potential community sites. •Promotional material sent to the site before each visit.	21 sites (18 community centres for migrants, refugees and the homeless; and three outpatient clinics).	n/a	Southern Eastern Melbourne Primary Health Network (SEMPHN); Monash Health (multi-site tertiary health network providing).	• 1,069 vaccines administered.
McPhee et al., 2003(49)	Two public health outreach catch-up campaigns for Vietnamese-American parents including media-led information and education campaign and community outreach mobilization strategy: *Notable features*: •*Media campaign*: Educational print media (translated, reviewed by Vietmanese-American physicians, consumers, advisories), electronic media (radio staffed by Vietnamese-American health experts to answer questions), outdoor media (billboards designed by a local Vietnamese advertising firm, culturally appropriate design posted in areas with high Vietnamese presence). •*Community mobilization strategy*: coalition with 3 committees: advisory committee, planning committee, and outreach committee; bilingual, bicultural project coordinator and health care providers hired; promoted physician registration; health education brochures & targeted mailings; health fairs; presentations at community-based organizations; home visits to new refugees; weekly work at community clinics; incentives for vaccination.	Houston, Texas metropolitan area (media campaign); Dallas metropolitan area (community mobilization strategy)	n/a	East Dallas Counseling Center (EDCC) (Vietnamese-American community-based organization); Community Health Network at Research and Development Institute	•Community mobilization strategy doubled, and the media education tripled, the likelihood of a child receiving the HepB series. •Community mobilization and media campaigns significantly increased knowledge of Vietnamese-American parents about vaccination, and the receipt of "catch-up" vaccinations among their children.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Mellou et al., 2019(50)	Vaccination activities of children at refugee camps, reception and identification centers and community: *Notable features*: •European programme 'PHILOS - Emergency health response to refugee crisis' coordinated vaccine delivery with standard operating procedures. •Staff visited families door-to-door to assess vaccination needs and to inform about vaccination program; written information in multiple languages; cultural mediators, •Meeting with UNHCR and partner NGOs to assess vaccination coverage of refugee children living in the community and opportunities for coordination. •Interventions at safe zones - to accommodate unaccompanied minors. •Vaccination campaign in camp at least once every 2 months.	Refugee camps, community, reception, identification centers, safe zones, Greece's seven health regions designated at least two community healthcare centres as refugee child vaccination centres.	Booklet for documenting vaccination history.	Ministry of Health ; UNHCR and partner NGOs; HCDCP; European programme 'PHILOS; Hellenic Centre for Disease Control and Prevention (HCDCP); Red Cross, Praksis, Doctors Without Borders (MSF) and Doctors of the World (MdM); 'Health for All' programme -University of Athens; Ministry of Migration Policy.	•57,615 vaccinations (MMR ((21,031), diphtheria-tetanus pertussis (7,341), poliomyelitis (7,652), pneumococcal disease (5,938), Haemophilus influenzae type b (7,179) and hepatitis B (8,474)) •More than 80% of children received the first MMR dose, 45% for the second dose.
Milne et al, 2006(51)	School-based immunisation program for refugee and migrant students (trial): *Notable features*: •Surveyed students with surveys translated into 6 languages. •Students encouraged to attend their local general practitioner for the third dose of hepatitis B vaccination in order to link them to PHC services. •Vaccine information provided to students and their families.	Intensive English Centre (IEC) high school.	Surveyed students (self-reported immunization status), if not vaccinated, offered MMR vaccine; Immunisation provided to all who consented regardless of self-reported status; immunisation card given.	Intensive English Centre (IEC) high schools; PHC General practitioners.	• 142 (74%) received MMR vaccine, 151 (78%) received first dose of hepatitis B vaccine, 144 (95%) received the second dose of hepatitis B, and 34 (23%) received the third hepatitis B dose elsewhere.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Mitchell et al., 2021(52)	Global immunization program for US-bound refugees (USRAP Vaccination Program) administered in multiple sites across different countries and conditions to populations that may not fall within the traditional framework of either host/asylum country or US national immunization guidelines: *Notable features*: •Infrastructure developed to standardize program services (e.g., staff, tools, immunization schedule, procedures, documentation, implementation phases). •Implementation in 3 phases: 1st in 6 countries where IOM conducts the U.S-bound refugee health assessment in IOM clinical facilities. 2nd in smaller IOM programs with some lacking permanent clinics, mobile medical teams or sub-contracted medical facilities. 3rd expanded in over 50 countries where IOM not designated provider. •IOM regional hubs supported sites; antibody testing; counseling/health education materials (e.g. partnered with public health organization to develop print and video materials); schedule developed in consultation with CDC experts; IOM staff travel to remote refugee camps; IOM contracts with local clinics to administer vaccines.	The USRAP Vaccination Program (multiple sites, countries).	First doses during overseas health assessment with coordination of second doses; medical staff reviewed outside immunization records; vaccines administered by medical staff.	US Centers for Disease Control and Prevention; US Department of State; International Organization for Migration (IOM).	• Program active in over 80 countries on five continents. Nearly 320,000 examined refugees had 1 documented vaccine doses since program inception. • 95% of arriving refugees had 1 documented measles-containing vaccine.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Peterson et al., 2019 (53)	Community project providing free influenza vaccinations at community-based clinics to vulnerable populations (Minnesota Immunization Networking Initiative (MINI)): *Notable features*: •Surveyed clients in own language about influenza vaccination knowledge and attitudes, and data on community needs informed project. •Collaborated with community and faith-based organizations to deliver vaccinations and included in leadership. •Vaccination campaigns in nontraditional settings.	99 community-based vaccination clinics (e.g. places of worship, homeless shelters, and food pantries).	Hosts of non-traditional sites oversaw logistics such as client registration, room assignment, and interpretation as needed.	Community and faith-based organizations; Minnesota Department of Health, Fairview Health Services, African American, Latino, and American Indian Communities; Minnesota Faith Health Consortium; University of Minnesota, Luther Seminary; Emory University; Homeland Health Specialists.	•5910 vaccinations through 99 community-based vaccination clinics. •2893 (49.0%) respondents heard about the clinic through their faith community. •Reasons for choosing the clinic: 1707 (19.9%) indicated convenient location, 1159 (13.5%) free vaccination, and 1098 (12.8%) lack of health insurance to pay for vaccination.
Phares et al., 2016 (54)	Two-dose oral cholera vaccine campaign in a refugee camp along with mobile teams in the community: *Notable features*: •Enumerated target population in census 3 months before campaign and issued vaccine cards to each individual. •Fixed-post strategy (plus mobile teams) during two eight-day rounds (two weeks apart) plus one two-day round for persons who had missed their second dose. •Pre-campaign education/communication activities in months leading up to campaign including providing information to community leaders who informed their constituencies through town hall meetings, camp newsletter, informal communications. •Social mobilization by personal communications by community health workers during routine home visits, classroom presentations, posters, and reminders via loudspeaker on the days leading up to the campaign.	Maela refugee camp; mobile teams for house-bound, in hospital, and at schools.	Staff scanned barcoded vaccine cards to record date, time, and vaccine status for each refugee; if no vaccine card and vaccinated offsite by mobile teams, staff issued temporary cards.	Thailand Ministry of Public Health; Première Urgence-Aide Médicale Internationale (PU-AMI).	•63,057 OCV doses administered to a target population of 43,485 refugees. An estimated 35,399 (81%) refugees received at least one dose and 27,658 (64%) received two doses. •Estimated first dose coverage at 81% and second dose coverage at 64%.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Pollack et al., 2011 (55)	Pilot city-wide (BFreeNYC) media and educational outreach campaign and free Hepatitis B community-based screenings, vaccinations, and free or low-cost care: *Notable features*: •Multimedia campaign developed with an advertising agency targeting Asian Americans and refined in focus groups; advertisements in target ethnic publications, radio spots and ethnic television. •Free community screening services with community-based partners and screening surveys; standardized procedures with case management; educational workshops; website with information on screenings/educational materials. •Provided vaccinations and giving infected individuals free clinical evaluation and care at program sites. •Online database to coordinate all program activities, collect data, and report results; community leaders, clinicians, researchers, and politicians formed a coalition to develop program.	Primary care centres.	Uninfected individuals offered a three shot immunization series; vaccination offered at screening site.	Community health centers, social service groups, community-based organizations, city council members, public hospitals, physician groups, academic institutions.	•Out of 3,156 susceptible individuals, 2,253 received the first vaccination, and 1,652 received all three vaccinations.
Ponce-Gonzalez et al., 2021 (56)	Multicomponent health education campaign led by community health workers (CHWs) to increase influenza vaccination in Latinx communities: *Notable features*: •Virtual 2hr workshops with participants recruited by CHWs from community. •Bi-directional communication; over 60 CHWs developed messaging and served as trusted messengers to deliver that information to their communities through workshops, social media posts (e.g. Instagram), radio interviews, blog posts, flyers, other avenues of communication.	Virtual workshops.	n/a	Washington Department of Health; Community Health Worker Coalition for Migrants and Refugees (CHWCMR).	•Improvements in all questions about the definition of influenza, symptoms, risks, and 7 of 9 questions about treatments/vaccines. •Multimedia campaign reached over 10 000 social media users on Facebook; 3900 website visitors; over 800 influenza page visitors; over 500 LinkedIn connections.

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Sheikh et al., 2014 (48)	Large-scale campaign in refugee camps and host communities to co-administer IPV and OPV vaccines: *Notable features*: •299 teams (173 in camps, 126 in host communities) assigned to fixed posts in health facilities and to temporary fixed posts in each block in camps or host communities. •Mobile teams used to reach nomadic settlements; Each team included health-care worker and volunteers. •Focus group interviews conducted before the campaign to assess barriers and communication materials designed. •Campaign monitoring with standardized checklist.	5 refugee camps and surrounding communities on the Kenya-Somalia border.	n/a	•Global Polio Eradication Initiative (GPEI) partners; Ministry of Health of Kenya; refugee camp coordinating agencies; United Nations High Commissioner for Refugees Registry (UNHCR) office.	•128 967 children received OPV and 121 514 received IPV. •Coverage with OPV and IPV in the December campaign was 92.8% in refugee camps and 95.8% in host communities
Vita et al., 2019 (57)	Two types of vaccination campaign strategies delivered in asylum seekers' centres: *Notable features*: •Strategy 1 (first 3 years): monthly visits; Strategy 2 (last year): vaccinations offered directly upon arrival of migrants in the asylum seekers' centre by physicians of the healthcare facility. •Linguistic and cultural mediators. •Schedule-according to the age, national/regional immunization prevention plan, and Italian law.	Italian reception centre; asylum seekers' centre; ASC (accomodation centre for asylum seekers)	Interviews with parents to determine status; if documentation, missing, followed the Italian Schedule; computerized system for vaccination registry.	Italian Ministry of Health; National Health Service (NHS). Italian Regions; local public health companies (ASLs); Accommodation Centres for Asylum Seekers (ASC); Internal Healthcare Facility at ASC.	•3941 migrants, 85% vaccinated during their stay; total of 4252 vaccinations administered, covering 95% of minors and 85% of adults. •Increase from average of 10.5% of migrants vaccinated in the first three years to 66% in the last year.

Table 3
Thematic summary of models of vaccine delivery (n = 33) by WHO (2022) (23) priority action areas.

1. Driven by Data: Generate insights from social, demographic, and behavioral data to develop tailored, evidence-informed strategies.	
Use existing tools to generate, analyse and use evidence about each community's context, capacities, perceptions and behaviours; Obtain accurate refugee and migrant population estimates to facilitate the allocation of resources, vaccine procurement, deployment planning and to help to estimate vaccination coverage and needs in specific settings.	
COVID-19 Vaccine	***Other Vaccines***
Baseline data on vaccination coverage and target population numbers (26–28, 30, 33, 36)	*Baseline data on vaccination coverage and target population numbers* (40, 43, 44, 46, 48–52, 54, 55, 57)
Assessment of barriers/needs to vaccination (26, 28, 30, 33–36)	*Assessment of barriers/needs to vaccination* (43–48, 50, 53, 55)
Utilizing Frameworks (26, 28, 30, 31, 33, 34)	
2. Coordinate, plan and implement: Coordinate actions, policies, and vaccine strategies to achieve equity in vaccinations.	
Work proactively with community-based organizations, refugees and migrants' rights organizations and community leaders to identify challenges and devise concrete strategies to address them; Review the required national and local capacity for implementation, readiness, legal frameworks and regulatory requirements for vaccinating all refugees and migrants to ensure equal access to COVID-19 vaccines; Innovation in service delivery may be required to reach these populations; Plan, budget, deliver and evaluate	
COVID-19 Vaccine	**Other Vaccines**
Multisectoral collaborations (25–38)	*Multisectoral collaborations* (40–42, 44, 45, 47–50, 52–55, 57)
Co-design (28, 30, 32, 35–37)	*Co-design* (44, 53)
Working groups (26, 28, 30, 32, 33, 36–38)	*Working groups* (44, 49, 50, 55)
3. Address Key Barriers to Health and Vaccination Systems: Identify barriers and related issues, and adapt vaccination systems to the locality and intersectional identities.	
Engage with community organizations to identify drivers and barriers to vaccination; Utilize community and peripheral health centres as these are known to be more accessible for refugees and migrants, in particular for refugee and migrant women; Consider onsite camp settings, resettlement or workplace vaccination; Consider mass vaccination campaigns with women vaccinators to ensure social acceptability of services for refugee and migrant women in communities with gender segregation; Design enrolment and registration to be inclusive and accessible to all, and limit contingencies that exclude some people in the population.	
COVID-19 Vaccine	**Other Vaccines**
Strategies to reduce geographic barriers (25–34, 36, 37)	*Strategies to reduce geographic barriers* (40–42, 44–54, 56, 57)
Mobile outreach (25–27, 30, 31, 33, 34, 36, 37)	*Mobile outreach* (42, 44, 47–49, 52, 54)
Targeting key community & nontraditional locations(25–28, 30, 32, 36, 37)	*Targeting key community & nontraditional locations* (40–42, 45, 48, 50, 51, 53, 54, 56, 57)
Transportation (27, 29, 37)	■ *Refugee camps* (40, 48, 50, 54) / *asylum seekers' centres* (57)
Language & cultural support (25–30, 34, 36–38)	*Transportation* (46)
Translation services (25–30, 30, 31, 34, 37, 38)	*Language & cultural support* (40–44, 46, 49–51, 53, 55–57)
Ethnic staff and/or volunteers (26, 29, 30)	*Translation services* (42, 44, 53, 57)
Strategies to reduce administrative and other barriers (25, 27–30, 32, 33, 37, 38)	*Ethnic staff and/or volunteers* (43, 56)
Simplified registration (28–30, 32, 37, 38)	*Strategies to reduce administrative and other barriers* (46, 49, 53, 55, 57)
No documentation/ID required (27, 30, 36–38)	*Simplified registration* (57)
Free vaccines and services (25, 27, 32, 33, 37, 38)	*Free vaccines and services* (53, 55)
Social support assistance (27, 29, 37)	*Social support assistance* (49)
Extended hours (28, 30, 37, 38)	
4. Ensure effective communication and build trust: Ensure decision making apparatuses have effective forms of communication and accountability mechanisms.	
Ensure refugees and migrants are effectively included in national risk communication and community engagement strategies; Specifically work to build trust among refugee and migrant communities about COVID-19 vaccines; Culturally and linguistically appropriate, accurate, timely and user-friendly information should be provided, including key messages in accessible formats, co-designed with communities; Ensure feedback mechanisms and accountability.	
COVID-19 Vaccine	**Other Vaccines**

1. Driven by Data: Generate insights from social, demographic, and behavioral data to develop tailored, evidence-informed strategies.

Use existing tools to generate, analyse and use evidence about each community's context, capacities, perceptions and behaviours; Obtain accurate refugee and migrant population estimates to facilitate the allocation of resources, vaccine procurement, deployment planning and to help to estimate vaccination coverage and needs in specific settings.

COVID-19 Vaccine	*Other Vaccines*
Culturally-appropriate information (25–27, 29–33, 36, 38)	*Culturally-appropriate information* (40, 42–44, 47, 48, 50, 51, 53–56)
Multilingual information and educational materials (25, 26, 29, 31, 33, 36, 38)	*Multilingual information and educational materials* (44, 47, 48, 50, 51, 53, 56)
Print media (25–27, 29, 30, 33, 36, 38)	*Print media* (44, 46–56)
Educational events (26, 30, 31, 33)	*Educational events* (43, 54)
Virtual & technological approaches (25–28, 31, 32, 34–36, 38, 39)	*Virtual & technological approaches* (41, 56)
Social media (25–28, 31, 32, 34–36, 38, 39)	*Social media* (56)
Text-messaging/E-mail (27, 28, 30, 36)	*Text-messaging* (41)
Customized communications (26, 28, 35, 36)	*Customized communications* (49, 52, 56)
Trusted messengers (26–28, 30, 36, 38)	*Trusted messengers* (43, 45, 54, 56)

5. Monitor and respond to social media: Capitalize on social media to communicate, engage, and address information inequities.

Actively monitor social media and mainstream media to identify any anti-vaccine sentiment, fake information and rumours and respond in real-time; Use community feedback mechanisms for capturing community in-sights and concerns about the vaccines; Train frontline staff on the basics of infodemic management.

COVID-19 Vaccine	Other Vaccines
Monitor and respond to social media (26, 28, 31)	*Other social media interventions* (56)
Other social media interventions (25, 30, 32, 35, 36, 38, 39)	

6. Ensure effective community engagement: Create and maintain systems that meaningfully integrate and engage end users.

Facilitate community-led responses adhering to minimum standards for risk communication and community engagement approaches; Communicate with and provide orientation to local influencers and get their support for creating an enabling environment for vaccine introduction; Develop a community action plan to engage communities in planning social mobilization and communication activities.

COVID-19 Vaccine	Other Vaccines
Partner with community based organizations & community members (25–38)	*Partner with community based organizations & community members* (40–42, 44, 45, 47–53, 55–57)
Community engagement strategies (25, 26, 28, 30–34, 36, 37)	*Community engagement strategies* (40, 41, 43–45, 48–50, 53, 54, 56)
Planning (27, 28, 30)	*Planning* (43–45, 48, 49)
Promotion/social mobilization (26, 28, 30, 31, 33, 36, 38)	*Promotion/social mobilization* (42, 45, 48, 53, 54, 56)
■ *Local influencers* (26, 28, 30, 31, 33, 36, 38)	■ *Local influencers* (45, 53)
Intervention rollout (25, 26, 30, 31, 36, 38)	*Intervention rollout* (42, 44, 45, 49, 53, 54, 56)

7. Reinforce capacity and local solutions: Respond to community needs by building on current healthcare resources and amplifying local strengths

Improve training and awareness among health-care and frontline workers on the needs and perspectives of refugees and migrants, and ensure they have strategies to address these; Identify and map key stakeholders and health facilities that provide COVID-19 vaccination services for these populations and assess them for readiness, vaccination capacity, policy and protocols.

COVID-19 Vaccine	Other Vaccines
Partnering with local health services partners (25–33, 35–38)	*Partnering with local health services partners* (40, 41, 44, 45, 47–51, 53, 54, 57)
Improving staffing and capacity (27–31, 34, 38)	*Improving staffing and capacity* (42, 46, 55, 56)

8. Monitor, learn and evaluate: Plan and adapt through effective monitoring and evaluation

Measure vaccine uptake and coverage among the overall population, as well as among populations prioritized for vaccination; Continuously measure behavioural and social data to track and be responsive to changes over time; Demand planning should include plans and activities for the monitoring and evaluation of relevant activities linked with the NDVP and performance indicators; Monitor progress over time, prioritization and inequities; Aim for disaggregated vaccine uptake data so that national authorities can see the extent to which different groups are being reached.

COVID-19 Vaccine	Other Vaccines

1. Driven by Data: Generate insights from social, demographic, and behavioral data to develop tailored, evidence-informed strategies.	
Use existing tools to generate, analyse and use evidence about each community's context, capacities, perceptions and behaviours; Obtain accurate refugee and migrant population estimates to facilitate the allocation of resources, vaccine procurement, deployment planning and to help to estimate vaccination coverage and needs in specific settings.	
COVID-19 Vaccine	*Other Vaccines*
Vaccination coverage rates (25–31, 33, 36, 38)	*Vaccination coverage rates* (40–43, 45, 46, 48–52, 54, 55, 57)
Monitoring progress (26, 28, 33, 34, 36, 38)	*Monitoring progress* (40, 42, 44, 46–48, 50, 55–57)
Other outcome evaluations (26–28, 30–32, 34–37, 39)	*Other outcome evaluations* (43, 44, 47–49, 53, 55)
Frameworks (26, 27, 30)	

Table 4
Adherence of vaccine models of delivery (n = 33) to the WHO (2022) (23) priority action areas.

No.	Priority Action Area (WHO, 2022b)	COVID-19 Vaccine (number of studies)*			Other Vaccines (number of studies)*			Total (number of studies)		
		Y	S	N/NR	Y	S	N/NR	Y	S	N/NR
1	Driven by Data	6 (26–28, 30, 33, 36)	8 (25, 29, 31, 32, 34, 35, 37, 38)	1 (39)	14 (40, 43–46, 48–55, 57)	4 (41, 42, 47, 56)	-	25	7	1
2	Coordinate, Plan & Implement	14 (25–38)	1 (39)	-	16 (40–45, 47–50, 52–57)	2 (46, 51)	-	30	3	-
3	Address key barriers to health and vaccination systems	14 (25–38)	1 (39)	-	18 (40–57)	-	-	32	1	-
4	Ensure effective communication and build trust	15 (25–39)	-	-	18 (40–57)	-	-	33	-	-
5	Monitor and respond to social media	3 (26, 28, 31)	7 (30–32, 35, 36, 38, 39)	5 (27, 29, 33, 34, 37)	-	1 (56)	17 (40–55, 57)	3	9	21
6	Ensure effective community engagement	14 (25–38)	-	1 (39)	16 (40–45, 47–51, 53–57)	1 (52)	1 (46)	30	1	2
7	Reinforce capacity and local solutions	15 (25–39)	-	-	17 (40–42, 44–57)	-	1 (43)	32	-	1
8	Monitor, learn and evaluate	15 (25–39)	-	-	18 (40–48, 50–57)	-	-	33	-	-

**Interventions found: Y - Yes; S - Somewhat; N/NR - No or Not Reported*

Study Quality Assessment

Study quality was assessed using the Mixed Methods Appraisal Tool (MMAT) (24) (Additional file 5). MMAT was chosen as it is designed for the appraisal stage of systematic mixed studies reviews and allows for the appraisal of most common types of study designs (24). Each study was assessed by two reviewers (DG, HK) and if conflict arose, conflicts were discussed and re-assessed by the team. Each study was assessed for quality with the MMAT study type most closely matching the study design.

Results

Included Studies

A total of 18,177 articles were identified from 11 databases. After duplicates were removed, a total of n = 11,825 unique studies had titles and abstracts screened for eligibility with a total of n = 277 full-texts assessed for inclusion. After full-text screening, a total of thirty-three (n = 33) studies were included and synthesized in this review (Fig. 1). Full-texts were mainly excluded for reasons including focusing on assessing barriers to vaccination without providing vaccination (n = 62), wrong population (n = 36), or being reviews (n = 34) or editorials/perspectives (n = 30).

[Figure 1. PRISMA flow diagram of included studies (n = 33) – Insert]

Descriptive and Demographic Study Data

Type of vaccine

Included studies focused on the COVID-19 vaccine (n = 15) (25–39), with the remaining studies (n = 18) (40–57) focusing on other vaccines including influenza (n = 6) (42, 44, 46, 47, 53, 56), HPV (n = 2) (41, 43), Hepatitis B (n = 2) (49, 55), multiple vaccines (two or more) (n = 5) (45, 50–52, 57) (e.g., MMR, DTP, poliomyelitis, pneumococcal, Haemophilus influenzae type B, Hep B (50)), polio (n = 1) (48), cholera (n = 1) (54), and meningococcal (n = 1) (40) vaccinations. Studies with multiple vaccines included mandatory and non-mandatory vaccination schedules (Table 1).

Years of Publication, Location, and Sample Size

Years of study publication of all included studies ranged from 2003 to 2023 (25–57), with COVID-19 vaccine studies published between 2021 and 2023 (25–39). Most studies had interventions implemented in the United States (n = 17) (25–32, 41–44, 46, 49, 53, 55, 56), with the remaining implemented in Australia (n = 2) (47, 51), Italy (n = 2) (33, 57), Kenya (n = 2) (45, 48), Germany (n = 2) (34, 35), and studies from United Kingdom (36), Canada (37), Cameroon (40), Thailand (54), Greece (50), Switzerland (38), USA and Canada (39), and set in multiple countries globally (52). Sample size ranged from 20 individuals (34) in a pilot trial to 888,994 individuals targeted in a communication campaign (35).

Target Population Demographics

Most interventions targeted the vaccination of diverse age groups including children, youth and adults, with some interventions targeting guardians/parents of minors (Table 1). Interventions generally targeted populations from diverse ethnicities (n = 14) (25–27, 29, 33–35, 38, 42, 46, 51–53, 55). Some studies targeted specific ethnic groups (n = 16) (e.g., Sub-Saharan African (n = 2) (40, 57), East African (n = 3) (43, 45, 48), Latino or Latinx (n = 7) (28, 30–32, 41, 44, 56), Middle Easterner (n = 1) (50), Vietnamese (n = 1) (49), Malayalam (n = 1) (39), and Karen (n = 1) (54)), while certain studies did not specify targeted ethnic groups (n = 3) (36, 37, 47) (Table 1). Many studies broadly targeted underserved populations which included migrant groups as well as other minority communities (n = 11) (25, 26, 30, 31, 33, 36, 37, 42, 44, 47, 53). Underserved and minority communities included populations in various precarious or hard-to-reach conditions (e.g., rural communities (25, 26, 31), individuals in public housing (25), informal settlement dwellers (33), minority ethnic populations (25, 36, 37, 53), homeless (25, 33, 36, 42, 44), individuals with mental illness (36), elderly (44), sex workers (44), individuals in assisted living facilities (25), and substance using populations (36)). Based on study-defined terminology used to describe migrant populations, COVID-19 vaccine interventions specifically targeted refugees (n = 1) (27), migrants (n = 6) (26, 28, 31, 34, 35, 38) (e.g. undocumented migrants (38)), immigrants (n = 4) (25, 30, 32, 39), refugees and immigrants (n = 1) (29), refugees and asylum seekers (n = 1) (36), and migrants, refugees, and asylum-seekers (n = 1) (33) (Table 1). Among non-COVID-19 vaccine studies, interventions specifically targeted refugees (n = 4) (40, 48, 52, 54), immigrants (n = 7) (41, 43, 44, 46, 49, 53, 55), immigrants and refugees (n = 1) (42), migrants (n = 2) (45, 57), and migrants and refugees (n = 4) (47, 50, 51, 56) (Table 1).

[Table 1 - Insert]

Models of Vaccine Delivery

Included studies were largely heterogeneous by intervention (model of delivery) and study design, being mostly descriptive implementation studies outlining vaccine programs with various types of evaluations. Interventions were also of different scales and often had multiple components including vaccine planning, promotion, and vaccine delivery strategies. Among the COVID-19 vaccine studies, interventions included wide-scale information campaigns (n = 3) (26, 32, 35), mobile outreach programs (n = 5) (25, 31, 33, 36, 37), community vaccination campaigns (n = 5) (27–30, 38), small-scale educational sessions (n = 1) (39), and a small-scale pilot of a mobile app to assist with vaccine delivery (n = 1) (34) (Table 2).

[Table 2 – Insert]

All study interventions (n = 33) were further analyzed and summarized using *Strengthening COVID-19 vaccine demand and uptake in refugees and migrants: An Operational Guide* (23) according to the eight priority action areas (Table 3; Additional file 4) with adherence of studies to the priority action areas summarized (Table 4).

Driven by data

COVID-19 vaccine

Most models of delivery reported being driven by data albeit to different extents. *Baseline data on vaccination coverage and target population numbers* from various sources was most often used to plan interventions (26–28, 30, 33, 36). Many studies included only general data primarily from background literature relating to the target population (25, 29, 31, 32, 34, 35, 37, 38). Studies also actively *assessed target population barriers/needs to vaccination* prior to interventions (26, 28, 30, 33–36), including through surveys (28, 30, 36), analysis of online and on-the-ground discourse (26), and interviews with stakeholders and target populations (26, 34, 35). There was also a *reliance on frameworks* to drive interventions, with examples including the National Academies Framework for Equitable Allocation of COVID-19 Vaccine (33), the PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) model (30), and the HIPE (Health Information Persuasion Exploration) framework (26).

Other vaccines

Baseline data on vaccination coverage and target population numbers also underpinned most non-COVID-19 interventions (40, 43, 44, 48–52, 54, 55, 57). There was a wide spectrum of the level and type of data used to inform studies, which included active collection of target population numbers (e.g., census conducted in a refugee population three months prior to a campaign (54), enumerating populations with venue-based and door-to-door sampling (44), surveying population to assess vaccination coverage (51, 57)), as well as passive methods such as utilizing previously collected and available data (e.g., target population identified through refugee camp statistics (40), prior data on vaccination coverage (49)). Studies also *actively assessed barriers/needs to vaccination* prior to interventions (43–48, 50, 53, 55), similarly by utilizing surveys (46, 53, 55), door-to-door assessment (44, 50), meetings with stakeholders (47), as well as more reliance on focus groups (29, 38, 47, 48) (e.g. focus groups with participatory mapping using geospatial data to indicate movement patterns for migration (45)).

Coordinate, plan and implement

COVID-19 vaccine

Interventions often used extensive *multisectoral collaborations* to coordinate and implement interventions with collaborators from community, academic, social service, nonprofit, nongovernmental, and health service sectors (25–38). These included partnerships with existing local health services and the ministry of health (25, 27–31, 33–38) (e.g. coordination between health authorities, regional center and community partners (38)), non-profit, humanitarian non-governmental, and community organizations (27–32, 35–38) (e.g., multi-stakeholder collaboration involving non-profit organizations and community leaders to plan and tailor vaccine strategy for underserved community (27)), governments (31, 37) (e.g. partnerships with Consulates from different Latin American countries (31), collaboration at the governmental, academic, health, and community-based level (31)), and academic institutions (25–27, 30, 37) (e.g community, academic, public health partnership model (30)).

Multiple studies applied *co-design* strategies (28, 30, 32, 35–37) in interventions, with some studies specifically referencing the co-design method (30, 36, 37), designing interventions with local stakeholders (35), participatory design (32), and bidirectional communication between community and academic partners (28). Additionally, establishing specialized *working groups* was a common strategy to design and coordinate interventions (26, 28, 30, 32, 33, 36–38), such as multidisciplinary working groups (36, 38) (e.g. dedicated group within the regional vaccination program was formed to design and coordinate program (36), committees (33), advisory boards (32), a community-based COVID-19 task force and communication working group (28)).

Other vaccines

Multisectoral collaborations was also a common strategy among the other vaccine studies (40–42, 44, 45, 47–50, 52–55, 57). Concepts of *co-design* were also employed (44, 53) (e.g., community leaders involved as full partners (53), community-based participatory research (CBPR) approach (44)). Similarly, *working groups* were also used to reach target outcomes (44, 49, 50, 55) (e.g., community leaders, clinicians, researchers, and politicians formed a coalition to develop a program (55)).

Address key barriers to health and vaccination systems

COVID-19 vaccine

Addressing access barriers was a key consideration among most studies (25–38). *Geographic barriers* were often targeted (25–34, 36, 37) with a major strategy focusing on delivering interventions in *target community and nontraditional locations* frequently accessed by target populations (25–28, 30, 32, 36, 37). This included selecting areas in geographical proximity to the target community (e.g., proximity to free COVID-19 testing site at busy public plaza and transportation hub (30), rural areas (25), supermarkets (36)) as well as venues frequently accessed by the target population (e.g., at churches and schools (26), a recreational arena (37), community centres or community-based organizations (28, 32). *Mobile outreach* strategies were also frequently employed (25–27, 31, 33, 34, 36, 37) (e.g., mobile units (25, 31, 33), pop up clinics (36, 37), or door-to-door outreach (26, 27)). *Transportation assistance* was also provided to assist with service access (27, 29, 37).

Most studies also used *language and cultural supports* to increase vaccine uptake (25–30, 34, 36–38). *Translation services* were often utilized, such as on-site translators, healthcare staff speaking target languages, telephone translation services, trusted bilingual community members, and virtual translation tools (25–30, 30, 31, 34, 37, 38) (e.g., mobile application to assist with vaccine delivery (34), individual phone calls with language interpreters and use of professional interpretation service with iPads (27)). Studies also adopted *culturally-adapted practices*, often by staffing ethnic staff and/or volunteers (26, 29, 30). Unique methods included having trusted Spanish-speaking Latinx community members (30) and cultural brokers present at time of vaccination (37). *Strategies to reduce administrative and other barriers* were also used (25, 27–30, 32, 33, 37, 38). Frequently, this strategy involved *no ID/documentation required* to access vaccination services (27, 30, 31, 36–38), having a *simplified registration process* (28–30, 32, 37, 38) (e.g., walk-in model without need for appointment (28, 30, 37, 38), registration assistance by staff (28, 29)). Other financial and economic barriers were targeted through *free vaccines and services* (25, 27, 31–33, 37, 38) and *social support assistance* (37) (e.g., community agencies provided food hampers and social support to clinic attendees (37)). *Extended hours of operation* or long opening hours were also utilized to broaden vaccine availability (28, 30, 37, 38).

Other vaccines

Strategies to reduce geographic barriers were also commonly used (40–42, 44–54, 56, 57). *Targeted community and trusted non-traditional locations* were often utilized (40–42, 45, 48, 50, 51, 53, 54, 56, 57). For example, one model of delivery planned vaccination sites based on migration routes, temporary settlement locations, and areas potentially lacking healthcare services (45). Directly delivering vaccinations in *refugee camps* (40, 48, 50, 54) and asylum seekers' centres (57) was more common although *mobile outreach* strategies were similarly frequently utilized (42, 44, 47–49, 52, 54) with some reference to *transportation* assistance (46). *Language and cultural supports* were also frequently considered (40–44, 46, 49–51, 53, 55–57), often by means of provision of *translation services* (42, 44, 53, 57). *Cultural-appropriateness* of interventions occurred mainly through community feedback and provision of services by culturally-competent staff (40–43, 46, 49–51, 53, 55–57) (e.g., linguistic and cultural mediators act as intermediaries between model personnel and target groups (57)). Additionally, *strategies to reduce administrative and other barriers* were used (46, 49, 53, 55, 57), such as *free vaccines and services* (53, 55), *registration* (57) (e.g. single 'on arrival appointment' (57)), as well as *social support assistance* (49) (e.g. incentives from charitable agencies to offer prizes for vaccinations (49)).

Ensure effective communication and build trust

COVID-19 vaccine

The dissemination of *culturally-appropriate information* (25–27, 29–33, 36, 38) was a common strategy with a large focus on the provision of *multilingual information and educational materials* (25, 26, 29, 31, 33, 36, 38). Culturally and linguistically-appropriate information was often disseminated via print media (25–27, 29, 30, 33, 36, 38) (e.g. one intervention distributed multilingual leaflets in informal settlements which were designed in collaboration with support organizations (33)), or others used through various *virtual and technological mediums* (25–28, 31, 32, 34–36, 38, 39). Virtual approaches relied heavily on the use of *social media* (25–28, 31, 32, 34–36, 38, 39) (e.g., Facebook live sessions (25, 31), webinars (26, 39), social media advertisements with links to

vaccination appointment booking tools and information matched to user language (35), communication leaders sharing messages through social media platforms most widely used by their network members (28), posting of personal photos by community leaders (30) and community members (36) being vaccinated, and promotion of vaccines by local influencers on social media (36, 38)). Other types of information dissemination occurred via *educational events* (26, 27, 30, 33, 39) (e.g., vaccine townhalls (30)), *text messaging and e-mail* (27, 28, 30, 36), as well as other types of media (e.g. strategically located billboards (32), ethnic language radio shows (30–32), television channel (38)).

Customization of messaging was also performed (26, 28, 30, 32, 35, 36, 38, 39) through adapting of information to match target population needs and addressing community feedback. The use of *trusted messengers* was a frequent strategy exercised to spread vaccine information by enrolling local community members, leaders, and influencers (26–28, 30, 36, 38). For example, local church pastors and networks of outreach workers acted as trusted messengers (26), or communication leaders were recruited based on credibility in the community (28).

Other vaccines

Similarly, non-COVID-19 vaccine studies relied extensively on *culturally-appropriate information* dissemination strategies (40, 42–44, 47, 48, 50, 51, 53–56). Using *multilingual information and educational materials* was common (44, 47, 48, 50, 51, 53, 56). A high reliance on print media (44, 46–56) was utilized, with the addition of culturally-appropriate events (43, 54) (e.g. interactive educational sessions led by ethnic health professionals with culturally-tailored materials (43)). There were also some use of *virtual and technological approaches* (41, 56) (e.g., programs produced for the radio also broadcast live on social media platforms (56), *text-messaging* for vaccination appointment reminders (41)). Some studies also *customized* messages according to community and partner organization feedback (49, 52, 56) as well as made use of *trusted messengers* (43, 45, 54, 56).

Monitor and respond to social media

COVID-19 vaccine

Active monitoring and responding to social media strategies were observed in three COVID-19 studies (26, 28, 31). For example, Desens et al. analyzed discourse on social media to identify inaccurate and misleading narratives around COVID-19 and the vaccine using crowd-sourced reporting (26). The intervention used a mobile app by recruited individuals from the community ('SQUINTers') to detect and report online misinformation and create customized informational material ('SQUINTSTAGRAMS') to address misleading information (26). Another study documented misleading information shared by users concerning COVID-19 and the vaccines to dispel common misconceptions through Facebook live, open virtual forums, and online videos (31). Lohr et al. also used monitoring and responding to narratives, using community leaders' social media accounts to distribute COVID-19 messages and respond to questions, with staff systematically tracking concerns, refining messages in response to community feedback and changing facts, and addressing concerns at task force discussions (28). Multiple studies incorporated *other social media interventions* (25, 30, 32, 35, 36, 38, 39) without specifically tracking social media to adapt messages (e.g., Facebook live sessions (25), virtual platforms to interact directly with participants and clarify questions(39)). Customization of social media advertisements also occurred by assigning messaging to specific user ethnic backgrounds (35) and tailoring communication to specific groups (36).

Other vaccines

Although no active tracking of online messaging was reported in non-COVID-19 studies, an intervention which included informational content produced for the radio also shared content on multiple social media platforms and had live broadcasting by community health workers (56).

Ensure effective community engagement

COVID-19 vaccine

Partnering with community based organizations & community members was a common intervention strategy (25–38). This includes collaborations with non-profit organizations such as immigrant/migrant community organizations, community centers, and religious organizations (25, 27, 31, 36–38). Partnerships were also seen with community members and leaders (26–28, 31–34, 36, 37), as well as local peer vaccine ambassadors and alliances (25, 28, 30, 32, 33, 36).

Intervention plans and delivery commonly relied on *community engagement and social mobilization strategies* (25–28, 30–37). Examples include a community-centered neighborhood 'Motivate, Vaccinate and Activate' strategy (30), Rothman's community intervention approaches with community organization model (28), or community-based participatory research approach (32). Community was involved in various capacities, including during the *planning* of interventions (27, 28, 30) (e.g. non-profits and community leaders planned and tailored strategy (27), bidirectional communication between community members and academic partners to inform regional decision makers (28)), *promotion of interventions and social mobilization* (26, 28, 30, 31, 33, 36, 38) (e.g., at least 50 community partners were contacted and played crucial role in promoting vaccination program (38), community volunteer *Promotoras* acted as trusted messengers (26, 31), use of local influencers (26, 28, 30, 31, 33, 36, 38)), and *intervention rollout* (25, 26, 29–31, 36, 38) (e.g., community champions managed booking system for "pop-up" clinics in community locations (36)).

Other vaccines

Partnering with community based organizations & community members was also a common strategy in most non-COVID-19 vaccination interventions (40–42, 44, 45, 47–53, 55–57). *Community engagement strategies* were often utilized (40, 41, 43–45, 48–50, 53, 53, 54, 56) (e.g., community mobilization with 3 committees, including advisory, planning and outreach committees (49), community-based participatory research approach (44)). Community engagement strategies included collaborating on intervention *planning* (43–45, 48, 49) (e.g., pre-campaign focus groups to inform campaign design (48)), *promotion and social mobilization* (42, 45, 48, 53, 54, 56) (e.g., social mobilization through personal communications by community healthcare workers (54), use of local influencers (45, 53)), as well as *intervention rollout* (42, 44, 49, 53, 54, 56).

Reinforce capacity and local solutions

COVID-19 vaccine

Interventions often reinforced local solutions and the capacity of current health systems to increase uptake. This included partnering with and applying the skills, teams, and infrastructure of *local health services partners* (25–33, 35–38), including schools of medicine or nursing (25, 30), non-profit healthcare associations (26, 33), vaccine task force teams (25, 28, 30, 36), local public health services (28, 29, 31, 35–37), and trusted local health professionals (26, 27, 32, 36, 37, 39). For example, in some models of delivery, local health professionals included community health workers (26, 27, 32) or internationally trained medical doctors (37). Partnerships with existing health services often granted access to existing infrastructure, such as sharing health informatics systems (27, 30) and health facilities (27–29, 36) (e.g. using a community-based primary care clinic in a diverse community (29)). Collaborative models with local health services also included assistance with service coordination (27, 36). Examples include a Registered Nurse coordinator providing follow-up with patients declining vaccine (27), designing interventions with medical experts working with migrant communities (28, 35, 36, 38), and trusted healthcare professionals delivering regular focus groups and informal conversations to motivate vaccination (36).

Another prevalent strategy was *improving staffing and capacity* (27–31, 34, 38). This included hiring or acquiring additional healthcare staff (29, 30, 38) (e.g. coordinators and nurses (29), staff/peer vaccine ambassadors who previously worked with COVID-19 testing events (30) or with prior experience vaccinating migrant populations (38), and using existing teams from partner health facilities (27, 28). Training and the use of assistive tools also increased team capacity (28, 30, 31) (e.g., all staff provided regular refresher trainings to answer community member concerns (30), infectious disease experts clarified misunderstandings during weekly meetings (28), smartphone/tablet mobile application facilitated multilingual vaccine administration (34)).

Other vaccines

Similarly, non-COVID-19 interventions often reinforced local solutions by *partnering with local health services partners* (40–42, 45–47, 49–53, 55, 56). One example referred clients to their local general practitioner for the third dose of hepatitis B vaccination to link them to PHC services (51). *Improving staffing and capacity* was also an important strategy (42, 46, 55, 56) by recruiting students (42), utilizing existing teams from partner health facilities (57), as well as providing additional staff training (46, 55) (e.g. cultural training and awareness among healthcare and frontline workers (46)).

Monitor, learn and evaluate

COVID-19 vaccine

Studies monitored and evaluated interventions primarily by examining *vaccination coverage rates* (25–31, 33, 36, 38) (e.g., changes in vaccination rates assessed using public health data with zip codes (26), percentage of individuals from community organization client lists who received the vaccine (27), vaccine uptake data from national vaccination information systems (27, 36)). Other types of ongoing *progress monitoring* (26, 28, 33, 34, 36, 38) included weekly meetings to monitor project (33, 38), formative evaluation sessions with religious leaders and community health care workers (26), analysis of routinely collected data (36), reviewing progress by staff and sharing updates with regional leaders (28), and formative evaluation by stakeholders with qualitative assessment of pre-specified goals (37)).

Other types of outcome evaluations (26–28, 30–32, 34–37, 39) consisted of pre- and post- surveys used for an educational intervention to assess the change in vaccine confidence (39), observation of user experiences of a mobile application (34), a team member survey to assess strengths and opportunities for improvement (27), semi-structured interviews with program leaders to gather feedback (36), surveys with community members to gather reasons for receiving/not receiving vaccination (27, 32)). Innovative evaluation methods for social media interventions were also used by calculating the reach via online metrics and surveys (31, 32, 35) (e.g., appointment booking click counts, reach, estimated conversion rates with automatic tracking by Facebook (35)). Some studies also used *frameworks* to guide evaluations (26, 27, 30), including the RE-AIM framework for individual client-level and community-level outcomes (30), the HIPE™ framework on formative and impact evaluation (26), and Squire 2.0 guidelines for reporting the system-level work aimed at improving the quality of healthcare (27).

Other vaccines

Similarly, *vaccination coverage rates* were often used to evaluate non-COVID-19 vaccine interventions (40–43, 45, 46, 48–52, 54, 55, 57) through percentage of vaccine uptake or number of individuals vaccinated. Sources of vaccination data included daily compilation from campaign tally sheets (40), using a provider validation protocol to verify patient vaccination (49), or accessing health information systems (55). *Monitoring of progress* was also completed (40, 42, 44, 46–48, 50, 55–57) (e.g. through ongoing reporting of challenges and improving the coordination of interventions (50), reporting process measure outputs such as materials disseminated and presentations conducted (44)). *Other outcome evaluation*s were also used (43, 44, 47–49, 53, 55) (e.g. pre- and post-intervention surveys were used including knowledge gain (43, 49, 56) or change in interest in vaccination (44) for educational interventions). Other outcomes included retention rates (55), cost of care (55), as well as reasons for receiving/not receiving vaccination or choosing the clinic (47, 48, 53).

[Table 3 – Insert]

Overall Adherence to Priority Action Areas

All studies generally adhered to the priority action areas of the WHO (2022) guideline and were similarly aligned between COVID-19 and non-COVID-19 studies (23) (Tables 3 & 4). However, there was a gap in Priority Action 1, with multiple COVID-19 studies (n = 9) (25, 29, 31, 32, 34, 35, 37–39) not clearly driven by data. Additionally, only three (n = 3) COVID-19 studies (26, 28, 31) adhered to Priority Action 5 (Monitor and Respond to Social Media) and eight (n = 8) (30–32, 35, 36, 38, 39) used social media in their interventions without specific tracking of discourse. Among the non-COVID-19 studies, only one (n = 1) (56) study showed slight adherence to Priority Action 5 by utilizing social media in its intervention. COVID-19 vaccine studies also had more reference to relying on local influencers to disseminate messages (Priority Action 6) (Table 3).

[Table 4 – Insert]

Study Quality

Study quality was assessed using the MMAT (Mixed Methods Appraisal Tool, 2018) (Additional file 5). As studies were of various design types, study quality assessment was completed for the study design best matching the methodology of each study. Twelve studies (n = 12) were categorized as non-randomized quantitative studies (25, 32, 39, 41, 43, 44, 46, 47, 51, 54–56), ten studies (n = 10) as quantitative descriptive (28, 29, 38, 40, 42, 48, 50, 52, 53, 57), seven (n = 7) as mixed methods (27, 30, 31, 33, 34, 36, 45), two (n = 2) as qualitative (26, 37), and two studies (n = 2) as randomized controlled studies (RCTs) (35, 49). The two RCTs (35, 49) did not meet all quality criteria. Only thirteen (n = 13) studies (25, 29, 30, 33, 35, 37, 39, 41, 43, 44, 49, 51, 56) had clear research questions. The remaining twenty (n = 20) studies (26–28, 31, 32, 34, 36, 38, 40, 42, 45–48, 50, 52–55, 57) had vague research questions with general study aims often describing implementations and reporting on lessons learnt. Among COVID-19 vaccine studies, only one study met all quality criteria within the given study type (30).

Discussion

This scoping review reported on models of delivery of COVID-19 and other vaccines in refugee and migrant populations. Many known approaches to vaccine delivery for refugee and migrant populations were confirmed with emerging directions of COVID-19 vaccination models of delivery highlighted (Fig. 2).

[Figure 2. Summary of COVID-19 models of vaccine delivery for refugees and migrants - Insert]

In alignment with the findings of this review, it is recommended to implement best practices as reported in literature for vaccine delivery for refugee and migrant populations. These include developing tailored, culturally sensitive approaches that consider the specific barriers and characteristics of the target population (4, 6, 17, 19, 58–60). It also includes evidence-informed campaigns launched in target languages and adapted to local cultures (4, 9, 61) and improved accessibility of vaccines with convenient access points (e.g. mobile vaccine clinics, combining health-services, mass vaccination campaigns, and ease in vaccination registration (4, 6, 19, 61, 62)). Another key practice is to leverage community partnerships for enhanced trust with the target community, including multidisciplinary and multisectoral collaborations between public health authorities and non-governmental associations, agencies, and organizations already providing care to migrants (3, 4, 11, 16, 17, 59, 61, 63). This is especially important given that a multisectoral approach with deliberate collaboration among various stakeholder groups is considered a promising solution to jointly achieve policy outcomes and address complex public health challenges (64).

This review also highlighted emerging trends of COVID-19 vaccination models. Most notably, innovative uses of social media and technologies have been increasingly implemented. Although previous literature and guidelines have called for effective communication strategies to tackle vaccine hesitancy and overcome barriers to vaccination (3, 4, 17, 59), findings of this review present real-world uses of social media in the models of delivery of COVID-19 vaccines. Given the high level of vaccine hesitancy during the novel COVID-19 pandemic, often driven by fears of vaccine harms (8), lack of reliable information with a lack of awareness of vaccine benefits and disease risks (4, 8, 65), it is unsurprising that effective communication strategies were often prioritized in vaccine campaigns. Advanced customization capabilities driven by social media platforms were utilized with COVID-19 vaccine studies tracking online discourse and using personalized content to influence target populations. The WHO (4) similarly calls for using strategies to normalize vaccines with the use of social media, although specific ways in which social media should be employed have not been clearly outlined. An improved understanding of how to optimize social media use and the use of built-in analytics is expected to become more important to disseminate information to targeted communities, especially in multilingual contexts relevant to refugees and migrants. For example, literature found that migrants sparsely access public multilingual websites but mainly rely on Facebook for COVID-19 information and campaigns dramatically increase effectiveness from social media experts carefully designing posts with collaboration with managers of large social media pages (66).

Although studies often called for population needs assessment and customized interventions, many studies failed to use or report on the specific data used to drive interventions. Many studies rely on sparse baseline data to drive interventions, often without specifically disaggregating data by race or migration status. Many COVID-19 vaccine studies did not have clearly data driven strategies, specifically as related to establishing target population numbers and vaccination need. While literature calls for assessing context of data-driven interventions (4, 23), there is a lack of data for designing interventions, a finding reported elsewhere (62) (e.g. in Canada, limited COVID-19 disaggregated data was available) (62). However, given the large diversity of migrant populations, pan-migrant vaccination strategies may be erroneous. For example, in Alberta, Canada, a cross-sectional study on COVID-19 vaccine rates found that certain immigrant populations have higher vaccination rates than the local population, with disaggregated data revealing that public health interventions should focus on older immigrants, immigrants living in rural areas, and immigrants from specific continental backgrounds (67). Other factors, such as being an undocumented migrant (13, 14, 68) and the effects of targeted language use (69) have been important to understand how best to customize interventions. Therefore, a key part of vaccine delivery models should align with the intersectional realities of individuals by using disaggregated data and by identifying barriers to vaccine access with direct engagement with communities (62, 70). Furthermore, establishing or improving immunization information systems to capture vaccination data for refugees has similarly been suggested in literature as a way to increase customization of messaging and interventions (3, 60).

The high reliance on co-design approaches among COVID-19 vaccine interventions also aligns with recent literature recommending the use of participatory approaches (19) and community-based participatory research (71) for vaccination interventions. Although included studies provided various examples of co-design methodologies, and given the multi-pronged and complex nature of many interventions, increased reporting on the co-design roles for each component of the intervention is recommended.

Various frameworks were used by the COVID-19 vaccine studies to guide planning, implementing, and evaluating interventions. However, as each study used a different framework, future research should evaluate frameworks to ensure vaccination interventions for refugees and migrants are guided by sound evidence.

As frameworks and guidelines only provide general directions for intervention design, specific on-the-ground implementation strategies may need to be continually re-evaluated (e.g., the CMAJ Evidence-Based Clinical Guidelines for Immigrants and Refugees of the Canadian Collaboration for Immigrant and Refugee Health outlines recommendations based on general clinical protocols without specific implementation strategies related to cultural-appropriateness and access barriers (72)). Furthermore, evaluation frameworks used in the included studies (e.g., RE-AIM (30), HIPE (26)) may be useful tools specifically for research and program evaluations; however, further validation of these tools should be provided. For example, with the increased reliance on built-in social media evaluation tools (e.g., social media platform metrics), the tools need to be evaluated for clinical validity and effectiveness.

The specific targeting of refugees and migrants in vaccine models of delivery is aligned with the WHO's priority which calls for inclusive vaccine plans and strategies to reduce disease and death burdens of COVID-19 (2). However, even in successful COVID-19 programs such as in Canada, it has been stated that programs ultimately failed to achieve equity goals given various structural and administrative barriers (62). While public health authorities aimed to ensure that COVID-19 vaccines would be available to all regardless of insurance and migration status, in practice many individuals required health care and identification cards to receive COVID-19 vaccines or proof of vaccination (13). It is therefore recognized that effective on-the-ground strategies are closely impacted by systemic health access challenges (65). In unison with effective on-the-ground model of vaccine delivery strategies, broader attempts of strengthening general primary care health services with goals of universal access to services, (5) strengthening integration between immunization and other health programs, as well as COVAX-like initiatives are required to ensure equitable distribution of vaccines for effective models of delivery (4).

Strengths & Limitations

The strength of this study was its large scope and comprehensive search strategy. This scoping review included multiple intervention types, study types, and included a wide geographic scope. Additionally, the use of the WHO (23) framework to analyze models of care was highly useful for summarizing and assessing intervention components according to best practice guidelines for the target population. The wide scope of the review and the relevance of the WHO framework allowed researchers to categorize intervention practices, synthesize past and emerging trends related to vaccine delivery for refugees and migrants, and draw attention to key practices and future directions for vaccine delivery. However, the large heterogeneity of studies made direct comparison of interventions challenging, with the conclusions of this review providing broad rather than specific approaches to vaccine delivery for refugee and migrant populations. The analysis of the models of delivery was similarly limited by the heterogeneity of interventions and differences in the level of reporting. For example, as the scope of interventions varied (e.g., large-scale multi-component campaign versus small-scale education intervention) and terminology uses varied (e.g., migrant vs. immigrant), there were challenges in ensuring consistency in data extraction while using the WHO (23) guideline's broad concepts for priority action areas.

Other limitations relate to the study quality and exclusion criteria. Studies included in this review were of low to medium scientific rigor. Many studies had vague research questions and most did not meet all quality criteria. The allocation of studies according to study type within the MMAT tool is only a best approximation given most studies were program implementation descriptions lacking clearly outlined methodologies. Relevant case studies excluded during the screening process due to lacking evaluations may have presented useful models and may warrant further examination in future research.

Future studies may also consider disaggregating models of vaccine delivery by location of delivery (e.g., models specific to refugee camps, mobile outreach), ethnicity, country of delivery, or intervention scope and type. Additionally, a detailed examination of funding, advocacy, and multisectoral collaboration strategies required for mobilization and coordination may be of use to implementing partners. Lastly, as not all studies claimed clear success of campaigns, further analysis of the effectiveness of strategy components should be evaluated.

Conclusions

This review presented best practices for the delivery of COVID-19 vaccinations to refugee and migrant populations, highlighting emerging trends of refugee vaccination models of delivery. Actionable recommendations to increase vaccine uptake in refugee and migrant populations are described for academic, policy, clinical, and community audiences. The growing reliance on social media to address vaccine hesitancy, as well as the prevalence of co-design strategies, use of frameworks, and multi-pronged interventions are common strategies in models of vaccine delivery. Building upon best practices for refugee and migrant vaccine delivery, models of vaccine delivery should continue to focus on improving vaccine uptake by facilitating ease of access, eliminating barriers such as costs and registration qualifications, offering culturally-tailored services, having strong collaborations with community, and reinforcing existing healthcare and vaccine delivery systems. The identified need to target and evaluate specific and changing population needs warrants increased collection and use of accurate and up-to-date data to best customize interventions. Importantly, with the growing reliance on technology in healthcare, innovative models of delivering vaccines and ways of integrating end-users into frameworks will require rapid adaptation of vaccination approaches to emerging migrant needs.

Abbreviations

AEFI (Adverse Event Following Immunization)

CADTH (Canadian Agency for Drugs and Technology in Health)

CBO (community-based organization)

CDC (Centers for Disease Control and Prevention)

CHW (community health worker)

COVID-19 (Coronavirus Disease of 2019)

DTaP (diphtheria, tetanus toxoid and acellular pertussis vaccine)

DTP (diphtheria, tetanus, and pertussis)

EMR (electronic medical record)

HepA (Hepatitis A vaccine)

HepB (Hepatitis B vaccine)

Hib (Haemophilus influenza type B conjugate vaccine)

HPV (Human Papilloma Virus)

IGO (Inter-governmental organization)

IPV (inactivated polio vaccine)

IQR (interquartile range)

Mea (measles vaccine)

Meningo (meningococcal quadrivalent conjugate vaccine)

MMR (Measles Mumps Rubella vaccine)

NGO (Non-governmental organization)

OPV (live attenuated polio vaccine)

PCV13 (pneumococcal conjugate vaccine)

PHC (primary health care)

PICOS (Population, Intervention, Comparison, Outcomes, Study Design)

Pneumo 23 (pneumococcal polysaccharide vaccine)

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

Rota (rotavirus vaccine)

SD (standard deviation)

Typ (typhoid vaccine)

UN (United Nations)

UNHCR (The UN Refugee Agency)

UNICEF (United Nations Children's Fund)

Var (Varicella vaccine)

WHO (World Health Organization)

Declarations

Ethics approval and consent to participate - Not applicable.

Consent for publication - Not applicable.

Availability of data and materials - Additional data related to the search strategy, analysis, and terminologies are made available (see Additional files).

Competing interests - The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Tables

Table 1: Descriptive and demographic data of included studies (n=33).

Author, year	Host country (region*)	Ethnic background of intervention target population (population type)	Age (mean, median, and/or range, y) (± SD)* Gender	Sample size	Date/duration of intervention	Study design	Vaccine (brand*)
COVID-19 Vaccine							
Alcendor et al., 2022 (25)	USA (Tennessee)	Black (majority), Hispanic, Asian, Native American, Pacific Islanders, White (underserved and minority rural/urban communities including individuals in public housing, faith communities, assisted living/elder care facilities, workplaces, homeless/unsheltered individuals, and immigrants)	Age (range): <16: 141 16-29: 1395 30-49: 1742 50-64: 1085 65+: 532 Gender: n/a	4895	Mar 2021-Sept 2021	Non-randomized, quantitative	COVID-19 (Pfizer, Moc Johnson & Johnson)
Bentivegna et al., 2022 (33)	Italy (Rome)	Sub-Saharan African, North African (majority African), Asian, Middle Eastern (underserved/minority communities including informal settlement dwellers, homeless, migrants, refugees, asylum seekers)	Age (median): 24.9 (Tiburtina Station); 38.7 (Termini Station); 40.17 (Collatina Factory) Gender: Female: 18 (11.2%), Male: 142 (88.8%)	160	Jun 2021-Sept 2021	Observational, descriptive, qualitative/quantitative	COVID-19
Berrou et al., 2022 (36)	England	n/a (underserved/minority communities including non-English minority ethnic groups including refugees and asylum seekers (majority), homeless, Roma/travelers/boat people, and persons with learning difficulties, serious mental illness, drug and alcohol dependence, physical and sensory impairment, and dementia)	n/a	7979	Feb 2021-Aug 2021	Cohort study, retrospective descriptive, qualitative/quantitative	COVID-19
Desens et al., 2023 (26)	USA (California; Florida)	Black (Haitian, English-speaking Caribbean, southern Black), Hispanic, Punjabi, Hmong (underserved/minority communities including rural/farmworkers and migrants)	Age (range): 5-11 (Central Valley); n/a (Miami Dude)	n/a (county-wide populations)	May 2021-Dec 2021 (Miami-Dade, Florida); Feb 2022-June 2022 (Central Valley, California)	Observational, descriptive, case study, quantitative/qualitative	COVID-19 (Pfizer, Moderna)

Elmore et al., 2022 (27)	USA (Virginia)	Multiple ethnicities from over 20 countries with most common languages being Dari, Arabic and Nepali and countries of origin including Afghanistan, Bhutan/Nepal, Iraq, Democratic Republic of Congo, Syria, and Other. (refugees)	Age (mean): 36.5 (SD=16.4) Age (range): 12-15:112 (8%) 16 and over: 1215 (92%) Gender: Female 728 (55%), Male 594 (45%)	1,327	Dec 2020-May 2021 (campaign); Mar 2021-Feb 2022 (outcomes)	Non-randomized, quantitative/qualitative	COVID-19 (Moderna, F Johnson & Johnson)
Holdbrook et al., 2023 (37)	Canada (Alberta)	n/a (underserved/minority communities, self-identified racialized communities & migrants)	Age (range) (stakeholders only): <18: 1 20-29: 9 30-39: 38 40-49: 49 50-59: 28 60-69: 11 Gender (stakeholders only): Female: 91 (66.4%), Male: 46 (33.6%)	141 (stakeholders only)	Jun 5-6, 2023 (formative evaluation)	Observational, qualitative	COVID-19
Lohr et al., 2023 (28)	USA (Minnesota)	Hispanic/Latino (65%); Other (unspecified) (migrants inclusive of immigrants, refugees, and asylum seekers)	Age (mean): 40 (SD=14) Age (range): 5–11: 176 (15%) 12–17: 119 (10%) 18+: 847 (73%) Age (mean) (survey only): 43 (SD=10). Gender: Female 527 (46%), Male 584 (50%) Gender (survey only): Female: 30	985 (vaccination)/ 37 (survey)	Mar 27 2021-Dec 11, 2021	Non-randomized, quantitative	COVID-19

			(86%), Male: 5 (14%)				
Malone et al., 2022 (29)	USA (Georgia)	Black, White, Asian, Hispanic, Latino (immigrants & refugees)	n/a	3127	Jan 2021-May 28 2021	Non-randomized, quantitative	COVID-19 (Pfizer, Moderna)
Morisod et al., 2023 (38)	Switzerland (Canton of Vaud)	Individuals from 97 nationalities (migrants including undocumented migrants)	Age (mean): 38 Gender: Female: 48%	2351	26 May 2021-25 Oct 2021	Non-randomized, quantitative	COVID-19 (Spikevax)
Marquez et al., 2021 (30)	USA (California)	Latinx (majority, 70.5%), White (14.1%), Asian (7.7%), Black (2.4%), Other (5.3%) (immigrants of first generation and underserved/minority communities)	Age (median): 43 (IQR 32–56) Age (range): 16-30: 2530 (22.8%), 31-50:4658 (42.0%), 50-64: 2617 (23.6%), 65+: 1293 (11.7%) Gender: Male: 5978 (53.9%) Female: 4926 (44.4%), Non-binary/other: 194 (1.7%)	11098	Feb 2021 - May 19, 2021	Non-randomized, quantitative/qualitative	COVID-19 (Pfizer, Moderna)
Nair et al., 2022 (39)	USA & Canada	Malayalam (majority) (immigrants)	Age (range): 18–30: 9, 31–50: 59, 51–65: 21, >65: 2. Gender: Female: 33 Male: 58	92	2020-2021	Non-randomized, quantitative	COVID-19
Noack, Schaning, & Muller, 2022 (34)	Germany (Leipzig, Saxony)	Languages targeted Arabic, Romanian, Spanish (Latin American Spanish), Vietnamese, Albanian, English, Thai, Polish, Slovak, and Russian. (migrants)	Age (range) (pilot study only): 41-65: 11 18- 40: 8 Gender (pilot study only): Female: 8 Male: 12	20	2021	Non-randomized, pilot study, qualitative/quantitative	COVID-19 (Pfizer, Moc AstraZenec Johnson & Johnson (a content); Comirnaty BioNTech/F Spikevax Moderna (p study)
Rosales et al., 2023	USA	Latinx	n/a	245541 (all services); 31000	Feb 2021-Sept 2021	Non-randomized/observational,	COVID-19 a other vacci

(31)		(immigrants and underserved/minority communities including rural communities)		(COVID-19 vaccines)		qualitative/quantitative	
Shah et al., 2023 (32)	USA (Maryland)	Latino (immigrants)	n/a	424 (survey respondents) (305 122 reached through social media advertisements, 9607 web site visitors)	Mar 1, 2021-Mar 1, 2022	Non-randomized, quantitative	COVID-19
Tjaden, Haarmann, & Savaskan, 2023 (35)	Germany	Arabic, Turkish, Russian speakers (migrants)	n/a	888994	Nov 25, 2021-Dec 23, 2021 (Berlin); Dec 7 - Dec 23 2-21 (Germany)	Randomized controlled trial, quantitative	COVID-19
Other Vaccines							
Amani et al., 2021 (40)	Cameroon	From neighboring countries to Cameroon (mainly Central African Republic, Nigeria and Chad) (refugees in camp)	Age (range): >2	191652	Jul 2020-Sep 2020	Observational, quantitative, cross-sectional	Meningoco Meningitis, Y, W (Mena
Aragones et al., 2015 (41)	USA (New York)	Mexican (Immigrant [i.e. parents])	Age (mean) (parents only): 37 Age (range) (parents only): >18 Gender: Female (parents only): 78%	69 (parents only)	2012–2013	Non-randomized, pilot, quantitative	HPV
Brown et al., 2021 (42)	USA (Tennessee)	White 23.1%, Black/African American 12.3%, American Indian 0.7%, Asian/Pacific Islander 12.9%, Middle Eastern 15.9%, Other 1.1%, Missing 33.9%. (underserved/minority communities including homeless, low-income populations, immigrants, and refugees)	Age (mean): 40.8 Age (range): >8 Gender: Female:844 (48.7%), Male: 856 (49.4%), Missing: 33 (1.9%).	1733	2015-2019	Non-randomized, quantitative	Influenza
Chu et al., 2021 (43)	USA	East African (Somalia (80.7%), Ethiopia (16.7%), Eritrea (2.6%)) (immigrants)	Age (range) (mothers): <30: 3, 30–39: 65, 40–49: 38, 50+: 8.	115 (mothers)	Oct 2017 - Sep 2018	Non-randomized, quantitative	HPV

			Gender (mothers): Female: 114 (100%)				
Coady et al., 2008 (44)	USA (NYC)	Hispanic (72%) (underserved/minority communities including hard-to-reach populations in urban neighbourhoods including substance users, immigrants, elderly, sex workers, homeless persons)	Age (mean): 41 Gender: Female: 60%	6826	Jan 2005 - Mar 2005; Sep 2005 - Oct 2005	Non-randomized, quantitative	Influenza
Harvey et al., 2022 (45)	Kenya	Somali (migrant children)	Age (range): 0–59 months	2524 (measles vaccine)/2196 (polio vaccine)	Apr 2019 – May 2019	Non-randomized, qualitative/quantitative	Polio (bival OPV- types and 3), Mea
Hoppe & Eckert, 2011 (46)	USA (Washington)	West/East African (45%), African American (24%), Caucasian (12%), Hispanic (10%), Pacific Islander/Asian (6%), Native American (1%). (immigrant obstetric patients)	Age (mean): 27.8 Gender: Female: 100%	157	2009	Non-randomized, retrospective, quantitative	Influenza (H1N1)
Kong et al., 2020 (47)	Australia	n/a (underserved/minority communities including hard-to-reach populations such as homeless, including refugees and migrants (34%))	Age (range): 65+: 102 (10%) <18: 12% <5: 65 (6%)	1069 (vaccines)/1032 (surveys)	Apr 2018 - Oct 2018 (survey)	Non-randomized, quantitative	Influenza
McPhee et al., 2003 (49)	USA (Houston, Texas)	Vietnamese/Vietnamese-American (immigrant children)	Age (mean) (parents): 42.5 Age (range): 3-18 (children) 18-79 (parents)	1508 preintervention; 1547 post intervention (parents)	Apr 1998 - Mar 2000	Randomized, quantitative	HepB
Mellou et al., 2019 (50)	Greece	Syria (42.0%); Iraq (28.2%); Afghanistan (19.8%); Other (9.9%); Unknown (0.1%); (19 different nationalities recorded for the 375 children in the category of 'Other') (refugee and migrant children in camps and community)	Age (range): < 1: 285 (7.5%) 1–4: 1,224 (32.3%) 5–14: 2,277 (60.2%) Gender: Female: 1,720 (45.4%) Male: 2,002 (52.9%)	3786 (children in camps)	Apr 2017-Apr 2018	Non-randomized, quantitative	MMR, diphtheria-tetanus-pertussis (D poliomyeliti pneumococ Haemophilu influenzae t b, HepB

			Unknown: 64 (1.7%)				
Milne et al., 2006 (51)	Australia (Western Sydney)	From 32 countries speaking 35 languages (Asian (41%); Middle Eastern (26%), African (10%), European (10%), English (5%), Unknown (5%), Other (2%), Pacific (1%)) (refugee and migrant student children & youth)	Age (mean): 15 Age (range): 10-23 Gender: Female: 65 (39%) Male: 96 (58%) Unknown: 4 (2%)	165	Jun 2003 (survey)	Non-randomized, quantitative	MMR, HepE
Mitchell et al., 2021 (52)	Thailand, Nepal, Kenya, Ethiopia, Malaysia, and Uganda (Phase I); over 50 countries in Africa, Asia, Europe, Middle East, Americas	Africa, Asia, Europe, Middle East, Americas (refugees)	All ages	320000	Dec 2012-Sep 2019	Case study, quantitative/qualitative	DTP or Dtal Hep B, Hib+ MMR, bOPV IPV, Pneumococ conjugate, Rotavirus, T Tdap, Men-ACWY conjugate+, Varicella, Influenza
Peterson et al., 2019 (53)	USA (Minnesota)	Hispanic/Latino (35.4%), Asian/Pacific Islander (29.7%), Non-Hispanic white (9.8%), Not specified (13.9%), African American (6.2%), African-born (3.3%), Multiracial (1.0%), American Indian (0.7%). (immigrants and underserved/minority communities including racial/ethnic minority)	Age (range): 0-5: 242 (4.1%), 6-9: 486 (8.2%), 10-18: 1091 (18.5%), 19-44: 2107 (35.7%), 45-64: 1370 (23.2%), 65-74: (5.2%), 75+: (1.9%), Not specified: (3.3%) Gender: Female: 3049 (51.6%) Male: 2505 (42.4%) Other: 4 (0.1%) Not specified: 352 (6.0%)	5910	Oct 2017-Jan 2018	Non-randomized, case study, qualitative/quantitative	Influenza
Phares et al., 2016 (54)	Thailand	Karen (~75%) (refugees in camp)	Age (range): 1 or over Gender: Male: 22,758 (50%**)	43485	2013	Non-randomized, case study, quantitative	Cholera (ora two-dose)

			(**from the census of the whole camp of 45,524 refugees)				
Pollack et al., 2011 (55)	USA (New York)	Asian (majority), American/ Pacific Islanders, African, Carribean, Central/South American (immigrants)	Age (range): <20: (3.4%), 20-39: (37.6%), 40-59: (44%), >59: (14.8%)	8888	Mar 2004 - Jun 2008	Non-randomized, descriptive, pilot, quantitative	HepB
Ponce-Gonzalez et al., 2021 (56)	USA (Washington)	Latinx (migrants & refugees)	Age (range): <30: 23.9% 30-39: 27.1% 40-49: 29% 50+: 20%	183	Jan 2021; May 2021	Non-randomized, quantitative	Influenza
Sheikh et al., 2014 (48)	Kenya	Somali (refugees in refugee camps and host communities)	Age (range, in months): 0-59	126000	Dec 2013	Non-randomized, descriptive, quantitative	Polio (IPV, C
Vita et al., 2019 (57)	Italy (Castelnuovo di Porto)	African (90%) (majority Sub-Saharan African) Asian (10%) (migrants)	Age (median): 5 (minors) Age (range): <18: 95% 18+: 85% Gender: Female: 236 (6%)	3941	Apr 2013-Mar 2017	Cross-sectional, quantitative	Ddiphtheria tetanus, pertussis, H poliomyeliti (inactivatec IPV), Haemophilu influenzae t b (Hib), (combinatic Infanrix Hex Hexyon, Tetravac. Tetraxim, PolioBoostr MMR & Var (Priorix Tetr ProQuad), pneumococ (Prevenar13 meningoco C (Menjuga Meningitec) HepB (Enge B), poliomy (Imovax Po HPV (Garda Varicella zo virus (Variv Varilrix)

*left blank if not specified.

Table 2: Summary of models of vaccine delivery of included studies (n=33).

Author, year	Intervention Type	Location	Vaccine registration & documentation process	Agency implementing/Overseeing intervention/campaign	Results
COVID-19 Vaccine					
Alcendor et al., 2022 (25)	Meharry Medical College COVID-19 mobile vaccine program (MMC-MVP) with free mobile vaccination outreach unit that travels to pre-arranged vaccine events in targeted areas providing education and delivering vaccines *Notable features:* •Collaboration with Hispanic/Latinx and immigrant community-based organizations for culturally-appropriate information provision. •Supported by disease experts, nurse practitioners, and community engagement personnel. •Multi-lingual flyers, infographics, Facebook Live sessions, on-site translators, bilingual medical staff.	Community venues in underserved urban/rural settings.	Vaccination status assessed and vaccination proposed at prescheduled vaccine events; database used for registration, vaccination card and information about second dose provided.	Meharry Medical College; Tennessee Community Engagement Alliance; Vanderbilt University School of Nursing; Bloomberg Foundation; COVID-19 vaccine strike teams; community-based/faith-based organizations.	•Vaccinated 4895 participants
Bentivegna et al., 2022 (33)	Vaccination campaign according to the *Framework for Equitable Allocation of COVID-19 Vaccine* with communication dissemination and vaccination delivery as part of free weekly health visits via mobile outreach to informal settlements: *Notable features:* •Long-standing collaborations with healthcare/social support services, inhabitants, and local committee (internal organizing committee with key authoritative figures in settlement). •Information leaflets distributed in informal settlements designed in collaboration with other support associations and translated into 10 languages by mediators; 'information days' organized. •Weekly meetings gathering data to optimize vaccination campaign.	Vaccination centers.	n/a	MEDU "Doctors for Human Rights" non-profit association; support organizations (e.g, Medicins Sans Frontiers, Caritas, Medici del mondo, local health authority).	•Vaccination coverage in transiting and resident populations was significantly different. •greater reticence to vaccination of the sub-Saharan population and eastern Europeans.
Berrou et al., 2022 (36)	'Maximising Uptake Programme' consisting of two key interventions: 1) engagement and communication targeting misinformation, and 2) outreach with pop-up clinics and other outreach providing vaccine: *Notable features:* •Dedicated workgroup designed and coordinated program with tailored interventions to each target population group. •Co-designed with community leaders and influencers (i.e., 'community champions') with learnings from pilot pop-up influenza clinics and community feedback. •Group 2 (Migrant group): written materials/social media outputs in different languages delivered; local	Group 2 (Migrants): "pop-up" clinics in community centres, mosques and gurdwaras and proximity to hotels, community centres, supermarkets, shops, parks, churches.	Bookings and appointments arranged by local community groups.	Maximizing Uptake Group (dedicated group within the regional Programme); Healthier Together partnership for Bristol, North Somerset and South Gloucestershire (BNSSG); community organizations.	• Vaccination of a total of 7979 high risk individuals through 162 outreach activities [Group 2: 7241 individuals; 93 outreach activities] •Qualitative results: use of community spaces effective; Eastern European community leaders difficult to identify with low engagement and higher vaccine hesitancy; examples of communication strategies provided.

	community influencers and healthcare professionals; community champions managed booking system; multilingual 'link workers'; streamlined services for asylum seekers/ refugees/undocumented migrants; focus groups/ informal conversations in community by trusted healthcare professionals. •Routinely collected quantitative and qualitative data by 'Insights and Engagement team'.				
Desens et al., 2023 (26)	Vaccination campaigns addressing vaccine hesitancy in two underserved communities with the application of the HIPE™ (Health Information Persuasion Exploration) Framework with the persuasion and behavioral change theory: *Notable features:* •Use of social media listening tool to report narratives of online misleading discourse and discourse analysis to inform the design of response and communication strategies customized to each subpopulation/language group, with a formative and impact evaluation. •<u>Miami-Dade Campaign:</u> mobile app for crowd-sourced reporting of social media and on-the-ground discourse by individuals recruited from local communities; development of social media communication; collaborated with churches and community (trusted messengers); regular webinar sessions/education at vaccination events. •<u>Central Valley:</u> partnered with trusted network of outreach workers (Promotoras, CHWs), door-to-door information dissemination; virtual messaging platform for reporting; partnership with schools; mobile vans for outreach; online message testing sessions.	•Miami Dade: churches in local communities; vaccine sites in local communities. •Central Valley: rural community sites (e.g. schools).	n/a	• Miami Dade: Florida International University (FIU); KTFF (Keeping the Faith to Fight). •Central Valley: Livingston Community Health (LCH) and Valley Onward; ACTIVATE (digital health collaboration).	•Both campaigns achieved their respective vaccine uptake goals. •Miami-Dade: over 850 vaccinations administered (goal was 800); vaccination rates increased by 25%. •Central Valley: vaccination rates for 5-11 year old children increased about 20% and 14%, respectively; overall vaccination rates increased compared to surrounding counties.
Elmore et al., 2022 (27)	Four-pronged strategy tailored to local refugees with vaccine appointments offered within the week at a mass vaccine clinic using a multisectoral partnership:	UVA vaccine clinic in retail space with parking close to IRC near neighborhoods with refugee	Door-to-door scheduling of appointments via tablets; flyers with scheduling information (i.e., via hotline); no cost and insurance/ID/immigration	University of Virginia (UVA) Health; UVA International Family Medicine Clinic (IFMC); local resettlement office of the International	•895 (67.4%) had at least one dose; of 895 with first dose, 843 completed two-dose series (94.2%). •Overall completion

	Notable features: •1) phone calls offering vaccination with language interpreters, 2) follow-up contact by registered nurse-care coordinator if declined/no contact, 3) mass direct messaging via text messaging or emails in multiple languages on how to schedule vaccine, 4) neighborhood door-to-door outreach. •Health system, non-profit, and community stakeholders planned and tailored strategy to community needs and shared resources (e.g., interpreters/mobile language interpretation service, health equipment, mobile language interpretation service, vaccine call centre staff, health information system). •Transportation rides to clinic, extended hours of services, 'language blocks' to serve different ethnicities.	families; outreach in seven specific neighbourhoods housing target population.	documentation required; appointments within week.	Rescue Committee (IRC); Blue Ridge Health District (BRHD); non-profits and community leaders.	rate of initial series: 63.5%. •Reasons for declining (171, 13%) included wanting to speak with a physician or family member first; pregnancy hesitation; postponing until after Ramadan.
Holdbrook et al., 2023 (37)	Outreach vaccination 'hockey hub' pop-up mobile clinic with multi-stakeholder collaboration in target community location: *Notable features:* •Co-designed and implemented by collaborative of stakeholders •Services in multiple languages with cultural brokers. •Free public transit to and from site; extended hours of operation; community agencies provided food hampers/social supports.	Pop-up mobile clinic in a large city-owned recreation center/arena.	•Free walk-up model, no appointments, open regardless of immigration status/documentation or health care coverage.	•CNC (Calgary East Zone Newcomers Collaborative) collective of immigrant services; community-based organizations; volunteers; healthcare workers; service providers supporting migrants and newcomers; municipal, provincial, federal governments.	•Respondents almost uniformly felt the vaccine clinic met its collaboratively defined goals •Patients reported near universal agreement that the clinic was convenient and safe •[2280 first dose COVID-19 vaccinations were delivered-reported elsewhere]

Lohr et al., 2023 (28)	Community-based vaccine clinics in target locations with community-engagement and bidirectional communication: *Notable features:* •Adopted CDC's Crisis and Emergency Risk Communication (CERC) framework and used Rothman's community intervention approaches for a community organization model. •Collaborated with multiple stakeholders to address population needs, promote clinics, adapt strategies, and volunteer at clinics. •Bidirectional communication between community and academic partners while informing regional decision makers. •COVID-19 Task Force formed communication working group and used a 7-step process to adapt and distribute COVID-19 messaging (i.e. developed message maps, recruited community-trusted communication leaders (CLs), messages adapted based on CL feedback and cultural appropriateness, distributed by CLs via virtual/social media platforms, bilingual staff systematically tracked/addressed concerns). •Communication in multiple languages and formats disseminated through social media and virtual messaging platforms.	Clinics at three elementary schools; community education center; non-profit that provides support services for im/ migrants.	Walk-ins but also had pre-registration; Staff and communication leaders pre-registered, sent reminders, followed-up on location and time for the second dose; flexibility in time and ease of registration.	Mayo Clinic COVID-19 Vaccine Allocation and Distribution Workgroup (COVAD); Rochester Healthy Community Partnership (RHCP); community-based COVID-19 Task Force; academic partners; public health department.	•Administered 1158 vaccines. •Participants viewed the intervention as acceptable; nearly all participants reported that the intervention convinced them to receive a COVID-19 vaccine.
Malone et al., 2022 (29)	Vaccination campaign in a target location at a community primary care clinic: *Notable features:* •Trusted relationships with culturally sensitive community partners. •Vaccination team with additional full-time staff hired and volunteers from a variety of racial/ethnic backgrounds and languages spoken. •Telephone translation services and information materials provided in multiple languages.	Community-based primary care clinic.	Community engagement coordinator and community partners assisted with registration and transportation.	Ethne Health (community-based primary care clinic); community partners/volunteers.	Partially or fully vaccinated 3127 individuals; 2692 were fully vaccinated
Marquez et al., 2021 (30)	"Motivate, Vaccinate, and Activate" community vaccination strategy using the theory-informed PRECEDE (Predisposing, Reinforcing, and Enabling	Neighborhood vaccination sites located outdoors, (e.g. parking lot across from free	Low-barrier scheduling, registration/vaccination: on-site registration 7 days a week; walk-up appointments; no need to	"Unidos en Salud" Latinx support (inc. San Francisco Latino Task Force-Response to COVID-19 (LTF),	• 20,792 vaccinations to community members.

	Constructs in Educational Diagnosis and Evaluation) Model: *Notable features:* •Community-academic-public health partnership model. •Strategy targeted various barriers to vaccination (e.g. trusted Spanish-speaking community members conducted door-to-door outreach; survey on attitudes to vaccine; culturally-tailored site with bilingual staff; peer vaccine ambassadors; interviews on Spanish language radio shows; vaccine townhalls; information on social media; adapted in response to eligibility criteria changes and site capacity). •Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework (evaluation).	COVID-19 testing site at busy public plaza and transportation hub)	show ID, residency/health insurance status/vaccine eligibility; automatic scheduling for second dose.	University of California, Berkeley, the Chan Zuckerberg Biohub, Bay Area Phlebotomy & Laboratory Services (BayPLS), Primary Health, San Francisco Department of Public Health (SFDPH)	•Program was highly Effective, 58% of clients reported they were vaccinated sooner because of the program. •Program had Fidelity: able to deliver each of the components strategy as originally intended. •Program was highly Acceptable, with 99% of clients reporting they would recommend site.
Morisod et al., 2023 (38)	Communication and vaccination campaign for undocumented migrants: *Notable features:* •Multilingual written material/questionnaire and interpreters. •Community partners had crucial role in promoting campaign; use of online social network groups with influential health care provider and members of community sending translated messages. •Multidisciplinary working group was formed including administrative, medical, nursing and pharmacy managers having expertise with migrant population. •System adapted to address administrative, language and cultural barriers. •Working group met weekly to monitor the project and make adaptations.	Regional center of general medicine and public health.	Low-barrier registration without health insurance or appointment needed to receive free vaccine; anonymous vaccination, extended opening hours; adapted administrative form to limit collection of personal information.	Cantonal health authorities; at least 50 community partners (e.g., migrant associations, churches, NGOs, etc.).	•2351 undocumented migrants without health insurance received at least one dose; 2164 (92%) received an appointment for a second dose (some participants had a history of COVID-19 and were considered fully vaccinated after one dose).
Nair et al., 2022 (39)	Short webinar conducted by an expert medical professional from target ethnic community explaining the efficacy and safety of the vaccine: *Notable features:* •Use of virtual platform to interact with participants directly and clarify vaccine questions. •Pre/post survey on confidence in receiving vaccine. •Recruited participants via social media.	Online webinar	n/a	n/a	•Participants reported greater confidence in receiving vaccine after webinar with statistically significant difference between pre- and post-webinar confidence scores.
Noack, Schaning, & Muller, 2022 (34)	Developed multilingual mobile application to assist healthcare providers to effectively deliver vaccines and user tested in a pilot with mobile outreach:	Mobile vaccination outreach teams across 6 outreach	App supports registration process, informed consent, medical history taking.	aidminutes GmbH (German e-health service provider); the Robert Koch Institute (German National Institute for	App demonstrated its usability and was well accepted by the vaccination candidates.

	Notable features: •Vaccination registration process, informed consent, medical history taking, and other vaccination content in 39 languages. •Spiral Technology Action Research (STAR) model to create app within a discursive process involving healthcare professionals (HCPs), literature/guidelines, field trials (e.g. listened to the target groups to determine needs; interviewed staff at vaccination centers).	deployments (user testing).		Public Health); German Federal Ministry of Health.	
Rosales et al., 2023 (31)	Mobile Health and Wellness Project with education and vaccination services with a fleet of mobile health units: *Notable features:* •Counseling, basic health screenings, referrals, and vaccinations. •301 local alliances made (e.g., state and local health departments, community-based organizations, Consulates, other). •Three strategic initiatives: *Disseminate and adopt, Inform and adapt, and Target and train.* •Key activities*:* Latinx essential worker and community involvement; cultural and linguistically adapted printed educational materials; dissemination via social media/radio/television/community events (virtual and in-person)/Facebook live/open virtual forums/community health fairs and events; collected common myths and adapted information; medical professionals at events to answer questions; feedback sessions on best practices generated 24 best practices; recruited and trained community health workers, volunteers, and students; outreach, trust building, and personalized orientations; health promoters (i.e. *Promotoras*) had specialized training and support in self-care.	11 mobile health units (vehicles) in remote communities.	Free, and accessible regardless of insurance coverage or immigration status.	•US Centers for Disease Control and Prevention (CDC); United States-Mexico Border Health Commission; Latino Commission on AIDS (LCOA); Alianza Americas (AA); National Autonomous University of Mexico; community based organizations; health departments; community (Promotoras de salud, volunteers and students)	•54,625 vaccines given; 31,000 COVID-19 vaccines •1,535,771 services to 245,541 people •Dissemination of information on social networks (Facebook, Twitter, Instagram, and YouTube), yielded: reach-341,860; reactions-9,890; comments-3,089 and shares-1,741. •104,991 COVID-19 services provided •Outreach: 1,006,410 Television, 427,870 r radio.
Shah et al., 2023 (32)	'*Sin Duda'* community-engaged statewide social media marketing campaign targeting ethnic communities to access project web site with COVID-19 and community-based services information: *Notable features:* •Community-based participatory research approach guided by community advisory board at each stage. •Project website with bilingual information and option to request community health worker (CHW) navigation to COVID-19 services.	Virtual & community-based venues (e.g., churches, consulate, parks)	Free community-based events conducted twice a week; COVID-19 bilingual hotline. .	Local community-based organizations (CBOs).	•Reached 305 122 people through social media; 9607 visitors to the web site. •1075 web site requests for COVID-19 vaccinations •Facebook was the most common means of exposure (n=5102; 84% of those exposed), WhatsApp (n=564; 53%). •61% (n=574) influenced their

	•Information developed taking into account cultural beliefs from diverse countries of origin and input from Latino community/team members (advisory board, CHWs, media designers). •First developed accessible COVID-19 testing and vaccination services in partnership with local CBOs. •Paid advertisements on social media and unpaid advertisements on community organization social media and virtual platforms. •Reach assessed by online metrics and surveys conducted at 30 different community-based venues.				decision to get vaccinated
Tjaden, Haarmann, & Savaskan, 2023 (35)	Targeted, low-cost, social media campaign for target migrant groups: *Notable features:* •Social media campaign with multiple advertisements encouraging vaccination, providing information, with easy access in multiple languages to vaccination appointment booking tools (online, telephone, or local walk-in locations). •Social media users exposed to one of 36 advertisements using simple, double-blind randomization automatically assigned by Facebook advertisement manager platform to native or German language (language experiment), government, doctor, family, leader messenger types (messenger experiment). •Design informed by best practice and interviews with local stakeholders working with migrant communities •Aggregate data tracked automatically by Facebook with extrapolated estimated conversion rates.	Virtual (i.e. Facebook).	Link in online advertisement to vaccination appointment booking tool/website with information (in user language).	Stakeholders working with local migrant communities (i.e. public health agency, social worker providers, agency for intercultural communication).	•Reach: 890,00 Facebook users. Migrants were 2.4 (Arabic), 1.8 (Russian) and 1.2 (Turkish) times more likely to click on advertisements translated to their native language compared to German-language advertisements. •Arabic and Russian speakers were more likely to click on the advertisement depicting the government official.
Other vaccines					
Amani et al., 2021 (40)	Preventive mass vaccination campaign in refugee camps (two rounds): *Notable features:* •Installation of fixed and temporary fixed posts. •Multiple levels of the Ministry of Health involved in planning and coordination; regional and district coordinating teams. •Advocacy, communication and social mobilization (e.g. training of media professionals, information	Refugee camps in Cameroon: Far-North, East region and the Adamawa within the second round.	Data and immunization information filled on vaccination cards and recorded in campaign tally sheets.	Cameroon Ministry of Public; Technical and financial partners (WHO, UNICEF, AHA and UNHCR).	Global vaccination coverage of 101.62%

	posters in both national languages). •Training of health workers and volunteers.				
Aragones et al., 2015 (41)	Parental education and text messaging reminders: *Notable features:* •Parental education consisting of 20-min one-on-one educational sessions. •Text messages in Spanish once a week reminding of child's vaccination eligibility with reminders sent until uptake of the first dose of the vaccine was reported, or for 6 weeks after recruitment.	Health Window program at the Mexican Consulate in New York City.	Those who attended the Health Window were approached to assess eligibility; registered for vaccination independently.	Mexican Consulate in New York.	88% series completion rate in the children of those who received text messages.
Brown et al., 2021 (42)	Interprofessional student-run vaccine outreach program (VOP): *Notable features:* •Free vaccination events in nontraditional community locations. •Community partner involvement to advertise/schedule vaccines, train incoming coordinators, lead vaccination events, obtain necessary staff and supplies. •Interprofessional collaboration between nurse practitioner, medical, nursing, and pharmacy students. •One-on-one conversations at events to educate and register for vaccination; volunteers and interpreters/telephone-based medical interpreting services at events.	Various community venues (e.g. local clinic conducting community outreach in immigrant/refugee populations).	Individuals attending events were screened and vaccinated.	Vanderbilt University School of Medicine's (VUSM) student-run free clinic.	1,803 influenza vaccines were administered at outreach events.
Chu et al., 2021(43)	Culturally-appropriate interactive educational events delivered by co-ethnic healthcare professional with mothers: *Notable features:* •Culturally appropriate dinner events with 20-min educational presentation in native language including video testimonial from mother from community and 20-min question and answer period. •Multi-step process to develop intervention including review of research on barriers/facilitators and conducting focus groups, feedback from community partners, and materials reviewed by co-ethnic research team. •Community partners provided contacts of mothers who might be	Dinners in the Seattle metropolitan area (8 Somali community, 2 Ethiopian community).	Vaccination data from health information system (including dates and number of doses).	University research team.	•Post-intervention, marked improvements in HPV- and HPV-vaccine-related knowledge, beliefs and attitudes. •Pre-intervention, only 16% of mothers reported that they were somewhat or very likely to vaccinate their child, compared to 83% post-intervention.

	interested in participating.				
Coady et al., 2008 (44)	Project VIVA (Venue-Intensive Vaccines for Adults), a multi-level community-based intervention with outreach and vaccine distribution activities targeting hard-to-reach populations at the individual, community organization, and neighborhood levels: *Notable features:* •Individual level: nurses and physicians delivered vaccinations. •Community organization level: presentations given to local community boards and organizations; vaccination. •Neighborhood level: informational flyers and pamphlets distributed in neighbourhoods. •Intervention working group met regularly throughout the project to guide project implementation and evaluation.	Door-to-door, on the street, at community based organizations; neighbourhoods (East Harlem/Bronx, NYC)	Offering vaccination in door-to-door and street-based settings.	Researchers; community members (intervention working group: community residents, community-based organizations (CBOs), academic institutions, local health department)	•Interest in vaccination significantly increased. •566 vaccines were administered door-to-door in 4 neighborhood Areas.
Harvey et al., 2022(45)	Targeted vaccination campaign using key migration routes of mobile population: *Notable features:* •Vaccination sites selected based on findings from focus groups with local ethnic community members regarding migration routes using qualitative and geospatial data with a participatory mapping technique. •Static teams at major crossing routes and border villages. •Community mobilizers and other leaders provided mass awareness sessions. •Concurrently provided nutritional support, vit A, albendazole •Engagement of international humanitarian organizations with department of health to ensure alignment of immunization service delivery.	•29 sites with active migrant presence.	n/a	International Organization of Migration (IOM); American Refugee Committee (ARC); Garissa County's Department of Health.	•Administered 2196 doses of bOPV and 2524 doses of measles vaccine to children.
Hoppe & Eckert, 2011(46)	Multifaceted intervention to increase vaccination in target obstetrics population with adapted clinical processes and educational sessions: *Notable features:*	Women's Clinic, Harborview Medical Center (HMC), Seattle, Washington (serves an ethnically diverse population)	•During obstetrical visits all pregnant patients enrolled at clinic at the time the vaccine became available, accessed via electronic vaccine registry.	Department of Obstetrics and Gynecology, Harborview Medical Center (clinical site for the University of Washington School of Medicine).	•Within the first month of H1N1 availability, 120 of total 157 obstetrics patients were vaccinated. •Overall coverage rate was 76%

	•Education video in waiting room in 9 languages and printed educational material. •Planned future obstetrical visits within 2 wks of anticipated vaccine. •Contacted patients personally in own language; medical interpreters invited; use of cultural case workers. •Taxi transportation. •Educational sessions for team members. •Created a real-time vaccine registry with electronic schedule prompts.				
Kong et al, 2020(47)	Mobile outreach influenza immunisation program ('VaxReach') for vulnerable populations in a resource-rich setting: *Notable features:* •Teams of nurse immunisers visited and provided vaccines to clients at multiple sites. •Key stakeholders met and discussed priority populations and potential community sites. •Promotional material sent to the site before each visit.	21 sites (18 community centres for migrants, refugees and the homeless; and three outpatient clinics).	n/a	Southern Eastern Melbourne Primary Health Network (SEMPHN); Monash Health (multi-site tertiary health network providing).	• 1,069 vaccines administered.
McPhee et al., 2003(49)	Two public health outreach catch-up campaigns for Vietnamese-American parents including media-led information and education campaign and community outreach mobilization strategy: *Notable features:* •*Media campaign*: Educational print media (translated, reviewed by Vietmanese-American physicians, consumers, advisories), electronic media (radio staffed by Vietnamese-American health experts to answer questions), outdoor media (billboards designed by a local Vietnamese advertising firm, culturally appropriate design posted in areas with high Vietnamese presence). •*Community mobilization strategy*: coalition with 3 committees: advisory committee, planning committee, and outreach committee; bilingual, bicultural project coordinator and health care providers hired; promoted physician registration; health education brochures & targeted mailings; health fairs;	Houston, Texas metropolitan area (media campaign); Dallas metropolitan area (community mobilization strategy)	n/a	East Dallas Counseling Center (EDCC) (Vietnamese-American community-based organization); Community Health Network at Research and Development Institute	•Community mobilization strategy doubled, and the media education tripled, the likelihood of a child receiving the HepB series. •Community mobilization and media campaigns significantly increased knowledge of Vietnamese-American parents about vaccination, and the receipt of "catch-up" vaccinations among their children.

	presentations at community-based organizations; home visits to new refugees; weekly work at community clinics; incentives for vaccination.				
Mellou et al., 2019(50)	Vaccination activities of children at refugee camps, reception and identification centers and community: *Notable features:* •European programme 'PHILOS - Emergency health response to refugee crisis' coordinated vaccine delivery with standard operating procedures. •Staff visited families door-to-door to assess vaccination needs and to inform about vaccination program; written information in multiple languages; cultural mediators, •Meeting with UNHCR and partner NGOs to assess vaccination coverage of refugee children living in the community and opportunities for coordination. •Interventions at safe zones - to accommodate unaccompanied minors. •Vaccination campaign in camp at least once every 2 months.	Refugee camps, community, reception, identification centers, safe zones, Greece's seven health regions designated at least two community healthcare centres as refugee child vaccination centres.	Booklet for documenting vaccination history.	Ministry of Health ; UNHCR and partner NGOs; HCDCP; European programme 'PHILOS; Hellenic Centre for Disease Control and Prevention (HCDCP); Red Cross, Praksis, Doctors Without Borders (MSF) and Doctors of the World (MdM); 'Health for All' programme -University of Athens; Ministry of Migration Policy.	•57,615 vaccinations (MMR ((21,031), diphtheria-tetanus pertussis (7,341), poliomyelitis (7,652), pneumococcal disease (5,938), Haemophilus influenzae type b (7,179) and hepatitis B (8,474)) •More than 80% of children received the first MMR dose, 45% for the second dose.
Milne et al, 2006(51)	School-based immunisation program for refugee and migrant students (trial): *Notable features:* •Surveyed students with surveys translated into 6 languages. •Students encouraged to attend their local general practitioner for the third dose of hepatitis B vaccination in order to link them to PHC services. •Vaccine information provided to students and their families.	Intensive English Centre (IEC) high school.	Surveyed students (self-reported immunization status), if not vaccinated, offered MMR vaccine; Immunisation provided to all who consented regardless of self-reported status; immunisation card given.	Intensive English Centre (IEC) high schools; PHC General practitioners.	• 142 (74%) received MMR vaccine, 151 (78%) received first dose of hepatitis B vaccine, 144 (95%) received the second dose of hepatitis B, and 34 (23%) received the third hepatitis B dose elsewhere.
Mitchell et al., 2021(52)	Global immunization program for US-bound refugees (USRAP Vaccination Program) administered in multiple sites across different countries and conditions to populations that may	The USRAP Vaccination Program (multiple sites, countries).	First doses during overseas health assessment with coordination of second doses; medical staff reviewed outside	US Centers for Disease Control and Prevention; US Department of State; International Organization for Migration (IOM).	• Program active in over 80 countries on five continents. Nearly 320,000 examined refugees had 1 documented

	not fall within the traditional framework of either host/asylum country or US national immunization guidelines: *Notable features:* •Infrastructure developed to standardize program services (e.g., staff, tools, immunization schedule, procedures, documentation, implementation phases). •Implementation in 3 phases: 1st in 6 countries where IOM conducts the U.S-bound refugee health assessment in IOM clinical facilities. 2nd in smaller IOM programs with some lacking permanent clinics, mobile medical teams or sub-contracted medical facilities. 3rd expanded in over 50 countries where IOM not designated provider. •IOM regional hubs supported sites; antibody testing; counseling/health education materials (e.g. partnered with public health organization to develop print and video materials); schedule developed in consultation with CDC experts; IOM staff travel to remote refugee camps; IOM contracts with local clinics to administer vaccines.		immunization records; vaccines administered by medical staff.		vaccine doses since program inception. • 95% of arriving refugees had 1 documented measles-containing vaccine.
Peterson et al., 2019 (53)	Community project providing free influenza vaccinations at community-based clinics to vulnerable populations (Minnesota Immunization Networking Initiative (MINI)): *Notable features:* •Surveyed clients in own language about influenza vaccination knowledge and attitudes, and data on community needs informed project. •Collaborated with community and faith-based organizations to deliver vaccinations and included in leadership. •Vaccination campaigns in nontraditional settings.	99 community-based vaccination clinics (e.g. places of worship, homeless shelters, and food pantries).	Hosts of non-traditional sites oversaw logistics such as client registration, room assignment, and interpretation as needed.	Community and faith-based organizations; Minnesota Department of Health, Fairview Health Services, African American, Latino, and American Indian Communities; Minnesota Faith Health Consortium; University of Minnesota, Luther Seminary; Emory University; Homeland Health Specialists.	•5910 vaccinations through 99 community-based vaccination clinics. •2893 (49.0%) respondents heard about the clinic through their faith community. •Reasons for choosing the clinic: 1707 (19.9%) indicated convenient location, 1159 (13.5%) free vaccination, and 1098 (12.8%) lack of health insurance to pay for vaccination.

Phares et al., 2016 (54)	Two-dose oral cholera vaccine campaign in a refugee camp along with mobile teams in the community: *Notable features:* •Enumerated target population in census 3 months before campaign and issued vaccine cards to each individual. •Fixed-post strategy (plus mobile teams) during two eight-day rounds (two weeks apart) plus one two-day round for persons who had missed their second dose. •Pre-campaign education/communication activities in months leading up to campaign including providing information to community leaders who informed their constituencies through town hall meetings, camp newsletter, informal communications. •Social mobilization by personal communications by community health workers during routine home visits, classroom presentations, posters, and reminders via loudspeaker on the days leading up to the campaign.	Maela refugee camp; mobile teams for house-bound, in hospital, and at schools.	Staff scanned barcoded vaccine cards to record date, time, and vaccine status for each refugee; if no vaccine card and vaccinated offsite by mobile teams, staff issued temporary cards.	Thailand Ministry of Public Health; Première Urgence-Aide Médicale Internationale (PU-AMI).	•63,057 OCV doses administered to a target population of 43,485 refugees. An estimated 35,399 (81%) refugees received at least one dose and 27,658 (64%) received two doses. •Estimated first dose coverage at 81% and second dose coverage at 64%.
Pollack et al., 2011 (55)	Pilot city-wide (BFreeNYC) media and educational outreach campaign and free Hepatitis B community-based screenings, vaccinations, and free or low-cost care: *Notable features:* •Multimedia campaign developed with an advertising agency targeting Asian Americans and refined in focus groups; advertisements in target ethnic publications, radio spots and ethnic television. •Free community screening services with community-based partners and screening surveys; standardized procedures with case management; educational workshops; website with information on screenings/educational materials. •Provided vaccinations and giving infected individuals free clinical evaluation and care at program sites. •Online database to coordinate all program activities, collect data, and report results; community leaders, clinicians, researchers, and politicians formed a coalition to develop program.	Primary care centres.	Uninfected individuals offered a three shot immunization series; vaccination offered at screening site.	Community health centers, social service groups, community-based organizations, city council members, public hospitals, physician groups, academic institutions.	•Out of 3,156 susceptible individuals, 2,253 received the first vaccination, and 1,652 received all three vaccinations.
Ponce-Gonzalez et al., 2021 (56)	Multicomponent health education campaign led by community health workers (CHWs) to increase influenza vaccination in Latinx communities:	Virtual workshops.	n/a	Washington Department of Health; Community Health Worker Coalition for Migrants and Refugees (CHWCMR).	•Improvements in all questions about the definition of influenza, symptoms, risks, and 7 of 9 questions

	Notable features: •Virtual 2hr workshops with participants recruited by CHWs from community. •Bi-directional communication; over 60 CHWs developed messaging and served as trusted messengers to deliver that information to their communities through workshops, social media posts (e.g. Instagram), radio interviews, blog posts, flyers, other avenues of communication.				about treatments/vaccines. •Multimedia campaign reached over 10 000 social media users on Facebook; 3900 website visitors; over 800 influenza page visitors; over 500 LinkedIn connections.
Sheikh et al., 2014 (48)	Large-scale campaign in refugee camps and host communities to co-administer IPV and OPV vaccines: *Notable features:* •299 teams (173 in camps, 126 in host communities) assigned to fixed posts in health facilities and to temporary fixed posts in each block in camps or host communities. •Mobile teams used to reach nomadic settlements; Each team included health-care worker and volunteers. •Focus group interviews conducted before the campaign to assess barriers and communication materials designed. •Campaign monitoring with standardized checklist.	5 refugee camps and surrounding communities on the Kenya-Somalia border.	n/a	•Global Polio Eradication Initiative (GPEI) partners; Ministry of Health of Kenya; refugee camp coordinating agencies; United Nations High Commissioner for Refugees Registry (UNHCR) office.	•128 967 children received OPV and 121 514 received IPV. •Coverage with OPV and IPV in the December campaign was 92.8% in refugee camps and 95.8% in host communities
Vita et al., 2019 (57)	Two types of vaccination campaign strategies delivered in asylum seekers' centres: *Notable features:* •Strategy 1 (first 3 years): monthly visits; Strategy 2 (last year): vaccinations offered directly upon arrival of migrants in the asylum seekers' centre by physicians of the healthcare facility. •Linguistic and cultural mediators. •Schedule-according to the age, national/regional immunization prevention plan, and Italian law.	Italian reception centre; asylum seekers' centre; ASC (accomodation centre for asylum seekers)	Interviews with parents to determine status; if documentation, missing, followed the Italian Schedule; computerized system for vaccination registry.	Italian Ministry of Health; National Health Service (NHS). Italian Regions; local public health companies (ASLs); Accommodation Centres for Asylum Seekers (ASC); Internal Healthcare Facility at ASC.	•3941 migrants, 85% vaccinated during their stay; total of 4252 vaccinations administered, covering 95% of minors and 85% of adults. •Increase from average of 10.5% of migrants vaccinated in the first three years to 66% in the last year.

Table 3: Thematic summary of models of vaccine delivery (n=33) by WHO (2022) (23) priority action areas.

1. Driven by Data: Generate insights from social, demographic, and behavioral data to develop tailored, evidence-informed strategies.

Use existing tools to generate, analyse and use evidence about each community's context, capacities, perceptions and behaviours; Obtain accurate refugee and migrant population estimates to facilitate the allocation of resources, vaccine procurement, deployment planning and to help to estimate vaccination coverage and needs in specific settings.

COVID-19 Vaccine	*Other Vaccines*
Baseline data on vaccination coverage and target population numbers (26–28,30,33,36)	*Baseline data on vaccination coverage and target population numbers* (40,43,44,46,48–52,54,55,57)
Assessment of barriers/needs to vaccination (26,28,30,33–36)	*Assessment of barriers/needs to vaccination* (43–48,50,53,55)
Utilizing Frameworks (26,28,30,31,33,34)	

2. Coordinate, plan and implement: Coordinate actions, policies, and vaccine strategies to achieve equity in vaccinations.

Work proactively with community-based organizations, refugees and migrants' rights organizations and community leaders to identify challenges and devise concrete strategies to address them; Review the required national and local capacity for implementation, readiness, legal frameworks and regulatory requirements for vaccinating all refugees and migrants to ensure equal access to COVID-19 vaccines; Innovation in service delivery may be required to reach these populations; Plan, budget, deliver and evaluate

COVID-19 Vaccine	*Other Vaccines*
Multisectoral collaborations (25–38)	*Multisectoral collaborations* (40–42,44,45,47–50,52–55,57)
Co-design (28,30,32,35–37)	*Co-design* (44,53)
Working groups (26,28,30,32,33,36–38)	*Working groups* (44,49,50,55)

3. Address Key Barriers to Health and Vaccination Systems: Identify barriers and related issues, and adapt vaccination systems to the locality and intersectional identities.

Engage with community organizations to identify drivers and barriers to vaccination; Utilize community and peripheral health centres as these are known to be more accessible for refugees and migrants, in particular for refugee and migrant women; Consider onsite camp settings, resettlement or workplace vaccination; Consider mass vaccination campaigns with women vaccinators to ensure social acceptability of services for refugee and migrant women in communities with gender segregation; Design enrolment and registration to be inclusive and accessible to all, and limit contingencies that exclude some people in the population.

COVID-19 Vaccine	*Other Vaccines*
Strategies to reduce geographic barriers (25–34,36,37)	*Strategies to reduce geographic barriers* (40–42,44–54,56,57)
Mobile outreach (25–27,30,31,33,34,36,37)	*Mobile outreach* (42,44,47–49,52,54)
Targeting key community & nontraditional locations(25–28,30,32,36,37)	*Targeting key community & nontraditional locations* (40–42,45,48,50,51,53,54,56,57)
Transportation (27,29,37)	■ *Refugee camps* (40,48,50,54) / *asylum seekers' centres* (57)
Language & cultural support (25–30,34,36–38)	*Transportation* (46)
Translation services (25–30,30,31,34,37,38)	*Language & cultural support* (40–44,46,49–51,53,55–57)
Ethnic staff and/or volunteers (26,29,30)	*Translation services* (42,44,53,57)
Strategies to reduce administrative and other barriers (25,27–30,32,33,37,38)	*Ethnic staff and/or volunteers* (43,56)
Simplified registration (28–30,32,37,38)	*Strategies to reduce administrative and other barriers* (46,49,53,55,57)
No documentation/ID required (27,30,36–38)	*Simplified registration* (57)
Free vaccines and services (25,27,32,33,37,38)	*Free vaccines and services* (53,55)
Social support assistance (27,29,37)	*Social support assistance* (49)
Extended hours (28,30,37,38)	

4. Ensure effective communication and build trust: Ensure decision making apparatuses have effective forms of communication and accountability mechanisms.

Ensure refugees and migrants are effectively included in national risk communication and community engagement strategies; Specifically work to build trust among refugee and migrant communities about COVID-19 vaccines; Culturally and linguistically appropriate, accurate, timely and user-friendly information should be provided, including key messages in accessible formats, co-designed with communities; Ensure feedback mechanisms and accountability.

COVID-19 Vaccine	*Other Vaccines*
Culturally-appropriate information (25–27,29–33,36,38)	*Culturally-appropriate information* (40,42–44,47,48,50,51,53–56)
Multilingual information and educational materials (25,26,29,31,33,36,38)	*Multilingual information and educational materials* (44,47,48,50,51,53,56)
Print media (25–27,29,30,33,36,38)	*Print media* (44,46–56)
Educational events (26,30,31,33)	*Educational events* (43,54)
Virtual & technological approaches (25–28,31,32,34–36,38,39)	*Virtual & technological approaches* (41,56)

Social media (25–28,31,32,34–36,38,39)	*Social media* (56)
Text-messaging/E-mail (27,28,30,36)	*Text-messaging* (41)
Customized communications (26,28,35,36)	*Customized communications* (49,52,56)
Trusted messengers (26–28,30,36,38)	*Trusted messengers* (43,45,54,56)
5. Monitor and respond to social media: Capitalize on social media to communicate, engage, and address information inequities.	
Actively monitor social media and mainstream media to identify any anti-vaccine sentiment, fake information and rumours and respond in real-time; Use community feedback mechanisms for capturing community in-sights and concerns about the vaccines; Train frontline staff on the basics of infodemic management.	
COVID-19 Vaccine	***Other Vaccines***
Monitor and respond to social media (26,28,31)	*Other social media interventions* (56)
Other social media interventions (25,30,32,35,36,38,39)	
6. Ensure effective community engagement: Create and maintain systems that meaningfully integrate and engage end users.	
Facilitate community-led responses adhering to minimum standards for risk communication and community engagement approaches; Communicate with and provide orientation to local influencers and get their support for creating an enabling environment for vaccine introduction; Develop a community action plan to engage communities in planning social mobilization and communication activities.	
COVID-19 Vaccine	**Other Vaccines**
Partner with community based organizations & community members (25–38)	*Partner with community based organizations & community members* (40–42,44,45,47–53,55–57)
Community engagement strategies (25,26,28,30–34,36,37)	*Community engagement strategies* (40,41,43–45,48–50,53,54,56)
Planning (27,28,30)	*Planning* (43–45,48,49)
Promotion/social mobilization (26,28,30,31,33,36,38)	*Promotion/social mobilization* (42,45,48,53,54,56)
■ *Local influencers* (26,28,30,31,33,36,38)	■ *Local influencers* (45,53)
Intervention rollout (25,26,30,31,36,38)	*Intervention rollout* (42,44,45,49,53,54,56)
7. Reinforce capacity and local solutions: Respond to community needs by building on current healthcare resources and amplifying local strengths	
Improve training and awareness among health-care and frontline workers on the needs and perspectives of refugees and migrants, and ensure they have strategies to address these; Identify and map key stakeholders and health facilities that provide COVID-19 vaccination services for these populations and assess them for readiness, vaccination capacity, policy and protocols.	
COVID-19 Vaccine	***Other Vaccines***
Partnering with local health services partners (25–33,35–38)	*Partnering with local health services partners* (40,41,44,45,47–51,53,54,57)
Improving staffing and capacity (27–31,34,38)	*Improving staffing and capacity* (42,46,55,56)
8. Monitor, learn and evaluate: *Plan and adapt through effective monitoring and evaluation*	
Measure vaccine uptake and coverage among the overall population, as well as among populations prioritized for vaccination; Continuously measure behavioural and social data to track and be responsive to changes over time; Demand planning should include plans and activities for the monitoring and evaluation of relevant activities linked with the NDVP and performance indicators; Monitor progress over time, prioritization and inequities; Aim for disaggregated vaccine uptake data so that national authorities can see the extent to which different groups are being reached.	
COVID-19 Vaccine	***Other Vaccines***
Vaccination coverage rates (25–31,33,36,38)	*Vaccination coverage rates* (40–43,45,46,48–52,54,55,57)
Monitoring progress (26,28,33,34,36,38)	*Monitoring progress* (40,42,44,46–48,50,55–57)
Other outcome evaluations (26–28,30–32,34–37,39)	*Other outcome evaluations* (43,44,47–49,53,55)
Frameworks (26,27,30)	

Table 4: Adherence of vaccine models of delivery (n=33) to the WHO (2022) (23) priority action areas.

No.	Priority Action Area (WHO, 2022b)	COVID-19 Vaccine (number of studies)*			Other Vaccines (number of studies)*			Total (number of studies)		
		Y	S	N/NR	Y	S	N/NR	Y	S	N/NR
1	Driven by Data	6 (26–28,30,33,36)	8 (25,29,31,32,34,35,37,38)	1 (39)	14 (40,43–46,48–55,57)	4 (41,42,47,56)	-	25	7	1
2	Coordinate, Plan & Implement	14 (25–38)	1 (39)	-	16 (40–45,47–50,52–57)	2 (46,51)	-	30	3	-
3	Address key barriers to health and vaccination systems	14 (25–38)	1 (39)	-	18 (40–57)	-	-	32	1	-
4	Ensure effective communication and build trust	15 (25–39)	-	-	18 (40–57)	-	-	33	-	-
5	Monitor and respond to social media	3 (26,28,31)	7 (30–32,35,36,38,39)	5 (27,29,33,34,37)	-	1 (56)	17 (40–55,57)	3	9	21
6	Ensure effective community engagement	14 (25–38)	-	1 (39)	16 (40–45,47–51,53–57)	1 (52)	1 (46)	30	1	2
7	Reinforce capacity and local solutions	15 (25–39)	-	-	17 (40–42,44–57)	-	1 (43)	32	-	1
8	Monitor, learn and evaluate	15 (25–39)	-	-	18 (40–48,50–57)	-	-	33	-	-

**Interventions found: Y - Yes; S - Somewhat; N/NR - No or Not Reported*

Figures

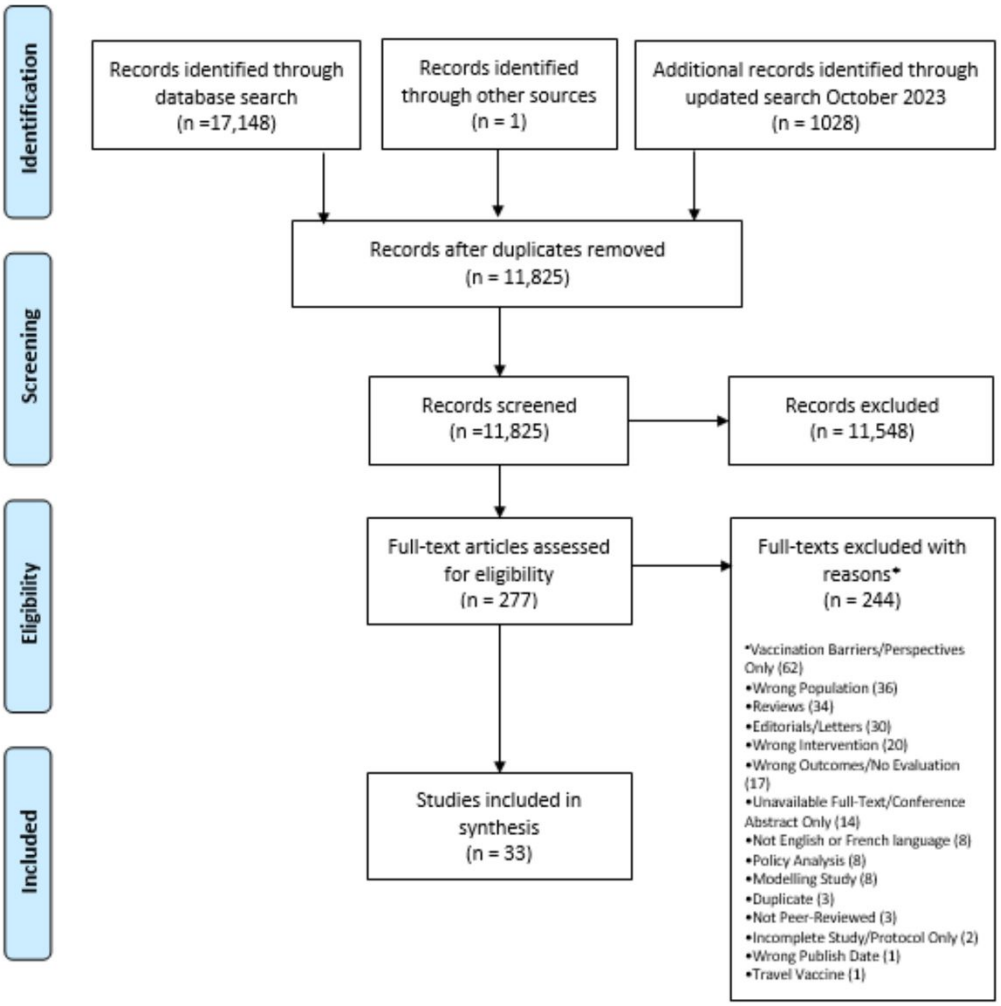

Figure 1

PRISMA flow diagram of included studies (n=33)

Figure 2

Summary of COVID-19 models of vaccine delivery for refugees and migrants

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.docx
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- Additionalfile3.docx
- Additionalfile4.docx
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