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Health system determinants of delivery and uptake of HPV vaccination services among involuntary migrant populations: A qualitative systematic review

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Plagiarism Declaration

I, Jennifer Nyawira Githaiga (KTHJEN002), hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

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Date: 17th April 2025

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To Almighty God, my inner strength and hope: Great is Thy faithfulness!

Acronyms

EU/EEA	European Union/European Economic Area
GEHM	Global Evidence Review on Health and Migration
HICs	High income countries
HPV	Human papillomavirus
HSS	Health system strengthening
IDPs	Internally displaced persons
IOM	International Organisation for Migration
JBI	Joanna Briggs Institute
LMICs	Low-and-middle-income-countries
MMAT	Mixed Methods Appraisal Tool
NIPs	National immunization programmes
PHC	Primary health care
RHAP	Refugee Health Assistance Programme
SDGs	Sustainable development goals
UASC	Unaccompanied and separated children
UHC	Universal health coverage
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
VPDs	Vaccine preventable diseases
VPR	Vaccination Programme for US-bound Refugees
WHO	World Health Organisation

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Health system determinants of delivery and uptake of HPV vaccination services among involuntary migrant populations: A qualitative systematic review

Targeted Journal: PLOS Global Public Health[1]

Jennifer Nyawira Githaiga[2]

Abstract

Migrant populations are commonly under-immunised relative to general populations in host countries. Under-immunisation has been linked to upsurges of vaccine preventable diseases. The evidence base on routine vaccination among migrant children suggests higher priority is given to infants and younger children compared to adolescents. Though migrants are often classified as a homogenous group, different sub-populations of migrants exist, including voluntary migrants who choose to move, and involuntary migrants forcibly displaced by humanitarian crises. The human papillomavirus (HPV) vaccine, a relatively recent addition to global routine immunisation schedules for adolescents and serves as a useful proxy for understanding vaccine equity for this under-prioritised group. This qualitative systematic review explores health system determinants of delivery and uptake of HPV vaccination services among involuntary migrants. A literature search was conducted across ten electronic databases. An analytical framework tailored to the migrant context aided in capturing the complexity and magnitude of systemic factors that determine vaccine delivery and uptake among involuntary migrants. Of the 600 records retrieved, 25 studies were included in this review. Key determinants of vaccine delivery include adaptation of immunisation policies for migrant inclusiveness, implementation of migrant-targeted interventions, health provider recommendations, electronic health records and free vaccines. Uptake determinants include access dependent on legal status, awareness-related determinants akin to culturally appropriate health messaging, and acceptance-related determinants associated with sociocultural beliefs, misinformation and distrust. Prioritising vaccination programmes linked with non-outbreak-related childhood diseases is challenging in the disruptive context of humanitarian crises given fragile health systems, limited resources, loss of health infrastructure and deployment of health personnel to emergency care, all of which sideline preventative services like HPV vaccination programmes. We strongly advocate for global actors at all health systems levels to actively restructure national HPV vaccination programs to enhance inclusivity of adolescent girls in crises settings or resettled in host countries.

Key words: Adolescents, cervical cancer, health system, HPV vaccination, migrants, policy

[1] See Appendix G for journal manuscript submission guidelines.

[2] For purposes of this mini dissertation, the student is the first and sole author of this systematic review. See co-author contributions on page 22.

Introduction

Globally, cervical cancer is the fourth most frequently occurring women's cancer, with approximately 660,000 new cases and 350,000 deaths reported worldwide in 2022 [1]. In several countries, predominantly low-and-middle-income countries (LMICs) in sub-Saharan Africa, Southeastern Asia and South America, cervical cancer is the most frequently occurring disease and the top cause of cancer-related deaths among women [1]. Women in LMICs are disproportionately impacted by cervical cancer [2, 3]. In 2018, 84% of cervical cancer incidence and 87-90% of cervical cancer mortality occurred in LMICs [3]. Further, the burden of cervical cancer is greater among younger women globally and specifically in LMICs, for instance in 2020, where while 20% of total maternal deaths occurred due to cervical cancer of which about 15% were aged 30-49 years [4]. In Southern and Eastern Africa, most cancer-related maternal deaths were due to cervical cancer [4]. Higher cervical cancer incidence rates and lower adherence to cervical cancer prevention measures have been reported among migrant women residing in high-income countries (HICs), mainly in Europe, compared to local women [5]. A study on cancer among migrants in Sicily, Italy documented higher cervical cancer incidence rates coupled with a higher odds ratio among migrants compared to the general population [6]. A Norway-based study observed that 52% of migrant women had not undergone cervical cancer screening and that the likelihood of not adhering to screening was 1.72 times higher among migrant women compared to native Norwegian women [7].

The leading cause of cervical cancer is incessant infection with high-risk human papilloma virus (HPV), which is sexually transmitted and accounts for over 90% of all cervical cancer cases worldwide [3, 8], particularly among women aged under 35 years [3]. As an infection-related cancer, cervical cancer can therefore be prevented through HPV vaccination, a proven cost-effective intervention in several countries worldwide [8, 9]. The World Health Organization (WHO) recommended routine vaccinations for adolescents including hepatitis B, tetanus-diphtheria-acellular pertussis booster, rubella and HPV series [10]. The HPV vaccine is a relatively recent addition and may serve as a proxy for understanding immunisation programs for adolescent migrants. Though HPV is not associated with vaccine preventable disease (VPD) outbreaks, curative cervical cancer management, particularly in low- and middle-income contexts (LMICs) where women develop cervical cancer during their most industrious years, may not only burden health systems but may also negatively impact national economies [11]. The WHO 90-70-90 strategy to eradicate cervical cancer as a global public health threat by 2030 [12] adopts a life course approach with three main targets; primary prevention through HPV vaccination of 90% of girls by the age of 15 years, secondary prevention through screening 70% of women at 35 years and at 45 years and tertiary prevention through treatment of pre-cancerous lesions and management of invasive cervical cancer among 90% of affected women [12]. Evidence demonstrates inequitable availability and adoption of HPV vaccination geographically in the WHO regions [2, 9]. By mid-2020, 85% of countries in the Americas and 77% of European countries offered HPV vaccine through their national immunisation programs (NIPs), in contrast to LMICs where the vaccine was available in 31% of African countries and 40% of Asian countries [13].

Migration is propelled by various factors, especially economic and political ones [14, 15]. Though migrants are often classified as a homogenous group, different sub-populations of migrants exist including persons who voluntarily choose to relocate to a new country of residence (voluntary migrants) as different from persons forcibly displaced by war and other humanitarian crises (involuntary migrants) [16, 17] (Box 1). Migrants may have some common needs and experiences but there are also variances evident among different migrant sub-populations. For example, involuntary migrants may have limited access to immunisation services during

conflict [18, 19] and while awaiting determination of legal status in host countries [20, 21] compared with voluntary labour migrants who may have more access [22-24]. Regarding routine immunisation (including HPV vaccination), all types of migrant populations are mostly under-immunised relative to the general population in host countries [20, 21, 25]. This trend was highlighted during the COVID-19 pandemic, with reports of migrants being excluded from accessing COVID-19 vaccination based on their migration status - for example Venezuelan migrants who fled to Latin America due to socio-political and economic instability [26]. Under-immunisation of migrants has been linked to upsurges of VPDs among migrant and general populations in various regions including some European countries and the United States of America (USA) [27, 28]. While there is a lot of focus on migrants in HICs, in fact, a significant proportion of migrants are hosted in LMICs. For example, it was estimated that in 2022, 76% of the world's refugees and other people requiring international protection were being hosted in LMICs [29].

Box 1: Typology of migrant sub-populations

Voluntary migrant: a person who chooses to relocate from their usual place of residence to a different location either within or outside of their country's borders e.g. labour migrants and international students.

Involuntary migrant/forcibly displaced: a person forcibly displaced within or outside of their country's border due to war, persecution and/or other humanitarian crises. Includes:

- *Asylum seeker* - a person seeking protection in a country outside of their home country but whose status is yet to be determined by the host country.
- *Refugee* – a person who is forced to leave their home country to seek international protection due to armed conflict, persecution and/or other humanitarian crises.
- *Internally displaced person* - a person forced out of their home who moves to a different location within their home country.
- *Unaccompanied and separated child/minor:* a person aged 18 years and below who has been separated from both parents and other legal guardians.

It has been widely suggested that the main barriers to migrants accessing vaccination in LMICs are systemic in nature [17, 20, 21]. These might be loosely divided into health system hardware and software factors. Structural factors related to health system hardware, that may impact vaccination service provision among migrant populations, include staff shortages, lack of clear policies, out-of-pocket costs for vaccination in the absence of free vaccination services and geographic/physical access to services [17, 20]. Less-tangible health system-related factors, referred to as software [30], include migrants' (mis)trust of vaccines, host governments and attendant healthcare systems, socio-cultural and religious beliefs, fear of discrimination based on legal status and knowledge gaps linked to language and literacy barriers [20, 21]. Health system hardware determinants play a key role in vaccination service delivery while software determinants have an influential role in determining uptake and more so, given the vulnerability of migrants linked to their status in host countries.

Applying a health systems lens entails comprehending the dynamism and complexity of interconnected, interdependent relationships between hardware and software, and viewing the various parts as components of the entire health system [31]. Understanding these health system determinants is a prerequisite to addressing vaccination-related disparities faced by migrant populations and ultimately, achieving the Immunisation Agenda 2030 goal of full vaccine access to all [32].

This qualitative systematic review was conducted to explore the question: *what are the health system determinants of delivery and uptake of HPV vaccination services among involuntary migrant populations?* The main objectives of the review were to describe health system determinants of delivery and uptake of HPV vaccination services among involuntary migrant populations and to enhance our comprehension of how these determinants may facilitate or impede provision and utilisation of migrant-inclusive HPV vaccination services among involuntary migrant populations. Based on our findings, we proposed recommendations for research,

policy and practice for key health system actors to support existing and future migrant-inclusive HPV vaccination services for involuntary migrant populations.

Materials and methods

We conducted a systematic review study was guided by a fully developed protocol (Appendix A) and preceded by a scoping review phase [33] which informed this qualitative systematic review. The systematic review follows the JBI guidelines for evidence synthesis [34] and the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 guidelines [35] (Appendix B).

Ethics statement

Formal ethics approval is not a requirement for a systematic review (Appendix C).

Eligibility criteria

Primary empirical qualitative, quantitative and mixed methods studies featuring HPV vaccination experiences among involuntary migrants (either as the sole focus or as a sub-population of migrants) were included as evidence sources. The inclusion and exclusion criteria are summarised in Table 1.

Table 1. Summary of inclusion and exclusion criteria (Source, Author)

Selection Criteria	Inclusion Criteria	Exclusion Criteria
Publication Genre	Peer reviewed journal articles	Non-peer reviewed publications/grey literature
Study Genre	Primary empirical studies	Secondary studies, including reviews
Type of study designs evidence	Qualitative, quantitative, mixed methods	Opinions, perspectives, commentaries
Population	Involuntary migrants/forcibly displaced	Studies that do not include involuntary migrants either as the main population or as a sub-population of migrants
Intervention	HPV vaccination	Vaccination other than HPV vaccination
Outcomes	Health system determinants of delivery and uptake of HPV vaccination services among involuntary migrant populations	Studies that do not include evidence on HPV vaccination services
Language	English	Languages other than English

Search strategy

The search strategy was developed in close consultation with an information specialist who guided the process of identifying relevant literature sources. The search, informed by a first phase scoping review (reported in Appendix A), was optimised by identifying key search words and variations of these including synonyms, using truncations, Boolean operators and medical subject headings (MeSH) terms, as appropriate, and optimising these across multiple databases. We developed a comprehensive search strategy for PubMed which was then adapted for other databases. We searched PubMed, Web of Science, Scopus and EBSCOHost (Academic Search Premier, Africa-Wide Information, Cumulative Index to Nursing and Allied Health Literature [CINAHL], Health Source Nursing/Academic Edition, Health Source Consumer Edition, APA PsycArticles and APA PsycInfo) databases. A summary of all the searches is documented in Appendix D. Manual searches of reference lists of articles and a supplementary search on Google Scholar were conducted to look for additional sources. No date limitations were applied to enhance the scope of our literature search. The search end date was October 2023.

Screening and study selection

Records were exported from the various databases to EndNote [36] to screen for duplicates, which were removed. The records were then exported to the Rayyan online management platform [37] for further

screening to eliminate any additional duplicates detected. This was followed by title and abstract screening completed in Rayyan. Next, full texts were retrieved and reviewed and those meeting the eligibility criteria were selected for inclusion.

Data extraction

The design and development of the data extraction tool was guided by the scoping review (Appendix A). Core variables included contextual information related to the circumstances of forced displacement, health system facilitators and barriers of HPV vaccine uptake and delivery, and outcome indicators of robust health systems. In keeping with institutional requirements of student research for academic degree purposes, the data extraction process was conducted by the primary author (student) in close consultation with both supervisors. The supervisors participated in the iterative process leading to the items included in the data extraction sheet, auditing the pilot data extraction sheet, and making recommendations for further enhancement, discussions about emerging data following a pilot data extraction exercise using a few studies, reviewing the final revised data extraction sheet (Appendix E) and discussions around emerging themes following completion of data extraction.

Data analysis and synthesis

An analytical framework was developed in the first scoping review phase (Appendix A) and drew from several existing frameworks. Given that immunisation service provision occurs within the broader context of the health system, exploring determinants of HPV vaccination delivery and uptake among migrant populations necessitates understanding these determinants in conjunction with health system factors, and how these interact in shaping attendant vaccination outcomes. Of the various frameworks utilised by scholars to explain vaccine-related behaviour, we drew from two frameworks deemed suitable for addressing our review objectives namely the P3 Model and the 5As Framework [38, 39]. The P3 Model explores how three key influences – (patient, provider and practice) – and how these interact and shape preventive care service provision, including immunisation services [38]. This framework has been used previously by a study conducted in the USA which investigated the factors shaping HPV vaccine decision-making among Vietnamese migrant mothers [40]. The 5As Framework posits that vaccine uptake is influenced by a complex array of structural, demographic and socio-behavioural factors namely the 5As: access, affordability, awareness, acceptance, and activation [39]. Four of the 5As resonate with facilitators and barriers of vaccination among refugees and migrants documented in the 2022 WHO Global Evidence Review on Health and Migration (GEHM) series report [17].

Two health system frameworks were included in the analytical frame applied in this review. First, the WHO framework, comprising six fundamental health system building blocks namely leadership and governance, health service delivery, health workforce, health financing, health information systems, and medical products, vaccines and technologies [41]. This framework served as a lens to explore health system factors that facilitate or impede vaccination delivery among migrant populations. Second, the Witter et al. Health Systems Strengthening Framework proposes a 'theory of change approach' focusing on effects that cut across several building blocks, attendant processes, and potential outcome indicators of strong health systems [42]. Drawing from the four frameworks, we developed an analytical framework specifically adapted for our review (Table 2). Information derived from the analytical model was captured in the data extraction sheet (Appendix E) and further synthesised, culminating in the narrative data presented in the results section. We employed the JBI meta-aggregation approach to qualitative synthesis which entails synthesising data from multiple studies, to

yield statements to inform policy and practice, in contrast to meta-ethnography which involves re-engaging with and re-interpretation of findings from individual primary studies [34].

Table 2. Analytical framework - health systems determinants of vaccination delivery and uptake among migrant populations (Source, Author)

Context ▪ Forced displacement/ involuntary migration e.g. due to war, persecution, humanitarian crises ▪ Global goals/policies: Immunisation Agenda 2030; WHO 2022 Global Evidence Review on Health and Migration; Universal health coverage			
5As framework domains	**WHO health system building blocks**	**Indicators of robust health systems**	**P3 model – health system influences**
▪ access	▪ service delivery	▪ equity	▪ provider level
▪ awareness	▪ medicines/vaccines	▪ quality	▪ patient level
▪ acceptability	▪ information systems	▪ resource mobilisation	▪ practice level
▪ acceptance	▪ finance	▪ high immunisation coverage	
▪ activation	▪ health workforce	▪ social/financial risk protection	
	▪ leadership/governance	▪ responsiveness	

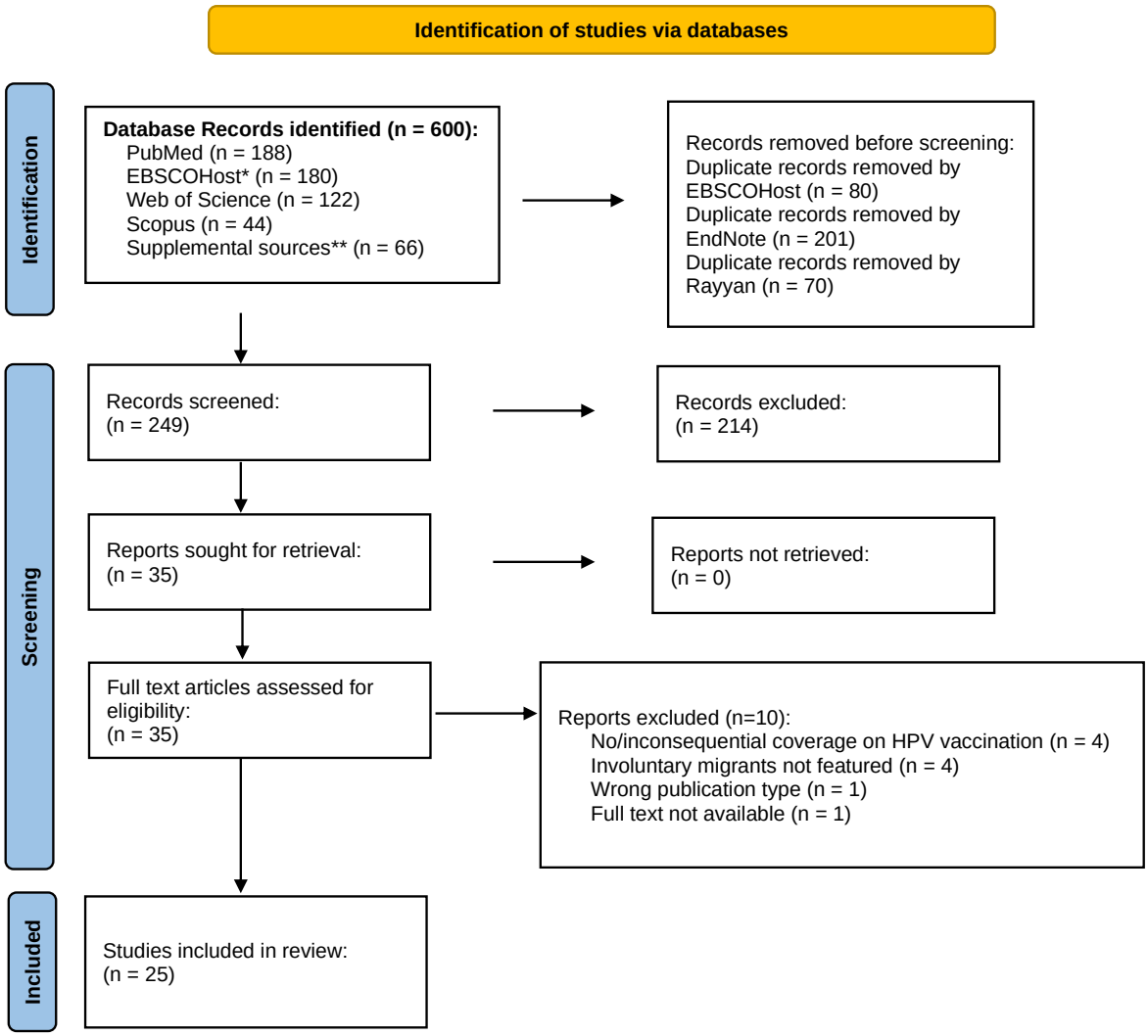
Quality assessment

Quality assessment was conducted applying the Joanna Briggs Institute (JBI) critical appraisal tools [43-45], and the Mixed Methods Appraisal tool [46] (Appendix F). Primary qualitative studies (9/25) were assessed using the JBI appraisal checklist for qualitative studies [43], a summary of which is presented in Appendix F, Figure A. Reflexivity was notably absent in 6/9 studies, in which there was neither mention of the researchers' cultural or theoretical leanings nor evidence of consideration of how researchers' presence might have influenced data collection. Two less common limitations were lack of clarity between methods and data collection and omitting a statement on ethical procedures followed in the research. However, the study that did not explicitly include an ethics statement reported longstanding collaboration in health-related research between the university research group and the community under study, including community leaders participating as interviewers [47], implicitly implying consent to conduct the study.

The JBI checklist for cohort studies [44] was used to appraise the quality of included cohort studies (6/25), summarised in Appendix F, Figure B. The main limitation identified was insufficiencies in explanations of how confounding factors were addressed in half of the studies. One study did not report adequately on follow-up time, making it difficult to establish if this time duration was ample for generation of anticipated outcomes. The JBI checklist for cross-sectional studies [45] was used to appraise the quality of cross-sectional studies (8/25), summarised in Appendix F, Figure C. Half of these studies did not provide adequate descriptions of the research subjects and/or the research context. Further, though 7/8 studies identified confounding factors, 5/8 of the studies did not explain how they dealt with such confounders. The Mixed Methods Appraisal Tool [46] was used to appraise the quality of mixed methods studies (2/25), summarised in Appendix F, Figure D. The first limitation was lack of clarity on the rationale for conducting a mixed methods study. The second limitation was not addressing methodological discrepancies between qualitative and quantitative results. All 25 studies were included, notwithstanding their methodological quality, because insights gleaned from these studies informed our results.

Results

The systematic search yielded a total of 600 articles of which 249 were screened, resulting in 25 articles meeting all inclusion criteria (Figure 1).



*EBSCOHost databases searched: Academic Search Premier, Africa- Wide Information, CINAHL, Health Source - Consumer Edition,
Health Source: Nursing/Academic Edition, APA PsycArticles and APA PsycInfo
**Supplemental sources obtained via manual citation searches and a supplemental search on Google Scholar.

Figure 1. PRISMA flow chart summarising identification and screening of included studies

Descriptive characteristics

Descriptive characteristics of the studies included are summarised in Table 3. Included items were descriptively analysed according to publication dates, study design, classification of migrants, home countries, host countries and health system actors featured. The studies were published between 2009 and 2023 with 11/25 studies (44%) published between 2020 and 2023. Of the 25 studies, 9/25 utilised qualitative designs [47-55], 8/25 were cross-sectional studies [56-63], 6/25 were cohort studies [64-69], while 2/25 utilised a mixed methods study design [70, 71]. One mixed methods item [70] and a cross-sectional item [59] reported on the same study, while the other mixed methods study [71] was a sequel to a qualitative item [54]. The most widely studied category of involuntary migrants was refugees, who were the sole focus of 14/25 studies. Of the 8/25 studies that used the classification 'refugees and migrants', 4/25 studies used this as a blanket term with no distinction between refugees and migrants [47, 53, 58, 62] while 4/25 studies (all Canada-based) included refugees as a sub-population of migrants [51, 52, 54, 71]. One study focused specifically on refugees and asylum seekers [69] while 2/25 studies distinguished between voluntary and involuntary migrants [63, 64].

Table 3. Descriptive characteristics of the 25 included studies (Source, Author)

Author/year	Design	Classification of migrants	Home countries/region(s)	Host countries	Actors e.g. providers, patients, caregivers
Allen et al, 2019	Qualitative	Refugees	Somalia	USA	mothers
Badre-Esfahani et al, 2020	Cohort	Involuntary vs. voluntary migrants	Central Asia, SE Asia, SSA, Latin America, Western countries; Turkey, Iraq, Lebanon, Pakistan, Afghanistan, Somalia, Iran, Morocco	Denmark	women
Berman et al, 2017	Cohort	Refugees	Predominantly Iraq, Bhutan Somalia & other SSA	USA	Adolescent males and females (9-26 years)
Bhatta et al, 2020	Cross-sectional	Refugees	Bhutan	Nepal	women
Burke et al, 2015	Qualitative	Refugees	Cambodia	USA	mothers
Dalla et al, 2022	Cross-sectional	Refugees	Syria	Greece	women
Do et al, 2009	Qualitative	Refugees/migrants	Cambodia	USA	parents and community leaders
Elmore et al, 2021	Cohort	Refugees	Afghanistan, Bhutan, Burma, Colombia, DRC Congo, El Salvador, Eritrea, Iran, Iraq, Moldova, Nepal, Syria, Russia, Sudan, Syria, Ukraine	USA	women
Gebre et al, 2021	Cross-sectional	Refugees/migrants	Somalia and Mexico	USA	women
Ghebrendrias et al, 2021	Qualitative	Refugees	Sudan, Somalia, Kenya, Ethiopia, Eritrea, Congo, Uganda, Syria, Iraq, Egypt, and Morocco	USA	women
Kenny et al, 2021	Cohort	Refugees	Burma	USA	adolescent females (11-26 years)
Kepka et al, 2018 (see Lai sequel study)	Mixed Methods	Refugees	Burundi, Congo, Rwanda, Liberia, Tanzania	USA	Parents, legal guardians, caregivers
Khan et al 2023	Qualitative	Migrants including refugees	Refugees from West Asia; migrants from South and Southeast Asia	Canada	parents
Kmeid et al, 2019	Cross-sectional	Refugees	Syria	Lebanon	Parents and legal guardians
Lai et al, 2017 (see Kepka sequel study)	Mixed Methods	Refugees	Burundi, Congo, Rwanda, Liberia, Tanzania	USA	Parents, legal guardians, caregivers
Lee et al, 2016	Cross-sectional	Refugees	Cambodia	USA	mothers
McComb et al, 2018	Qualitative	Immigrants including refugees	Africa, Asia, South America	Canada	women (16-26 years old)
Metusela et al, 2017	Qualitative	Refugees/migrants	Afghanistan, Iraq, Somalia, Sudan. Sri-Lankan (Tamil), Indian (Punjabi), South, South America (Latina) Sudan	Canada & Australia	women
Moller et al, 2018	Cohort	Refugees	Afghanistan, Asia, Eastern Europe (incl. Bosnia-Herzegovina, former Yugoslavia Middle East and North Africa (incl. Iraq, Stateless Palestinians) SSA (incl. Somalia)	Denmark	adolescent females
Napolitano et al, 2018	Cross-sectional	Refugees/immigrants	mainly SSA (64.5%), East Europe, South Asia, North Africa, South America, Central Asia	Italy	adolescent females (12-26 years) and parents
Nyanchoga et al, 2021	Cohort	Refugees and asylum seekers	42 countries - listed ones: Middle East (Afghanistan, Iran, Iraq); Asia (Myanmar, India, Pakistan, Sri Lanka); SSA (DRC, Eritrea, Ethiopia, Kenya, Somalia, Sudan); Papua New Guinea, Solomon Islands	Australia	children, adolescents and adults

Riza et al, 2020	Cross-sectional	Involuntary vs. voluntary migrants	Middle East incl. Syria, Afghanistan, and Iran; SSA incl. Nigeria, Ethiopia, Cameroon, and Kenya; Eastern European countries incl. Albania, Bulgaria and Georgia	Greece	women
Rubens-Augustson et al, 2019	Qualitative	Immigrants including refugees	Not given	Canada	health providers
Salad et al, 2015	Qualitative	Refugees	Somalia	Netherlands	women
Wilson et al, 2021	Mixed Methods	Immigrants including refugees	SSA (36%); MENA (58%); Other (6%)	Canada	adolescents (16-27 years) and caregivers
SSA – Sub-Saharan Africa; MENA – Middle East and North Africa; Migrants and immigrants used interchangeably					

Most involuntary migrants featured were from LMICs and resettled mostly in HICs, except for two studies conducted among migrants residing in LMICs namely, Nepal [56] and Lebanon [60]. Over half of the included items (15/25) featured migrants resettled in North America namely, the United States of America (USA) [47-50, 58, 59, 61, 65-67, 70] and Canada [51, 52, 54, 71]. There were six studies on migrants resettled in European countries namely, Denmark [64, 68], Greece [57, 63], The Netherlands [55] and Italy [62]. One study was conducted among migrants resettled in Australia while another study presented data on migrants resettled in Australia and Canada. Figure 2 shows the host countries featured in this review.

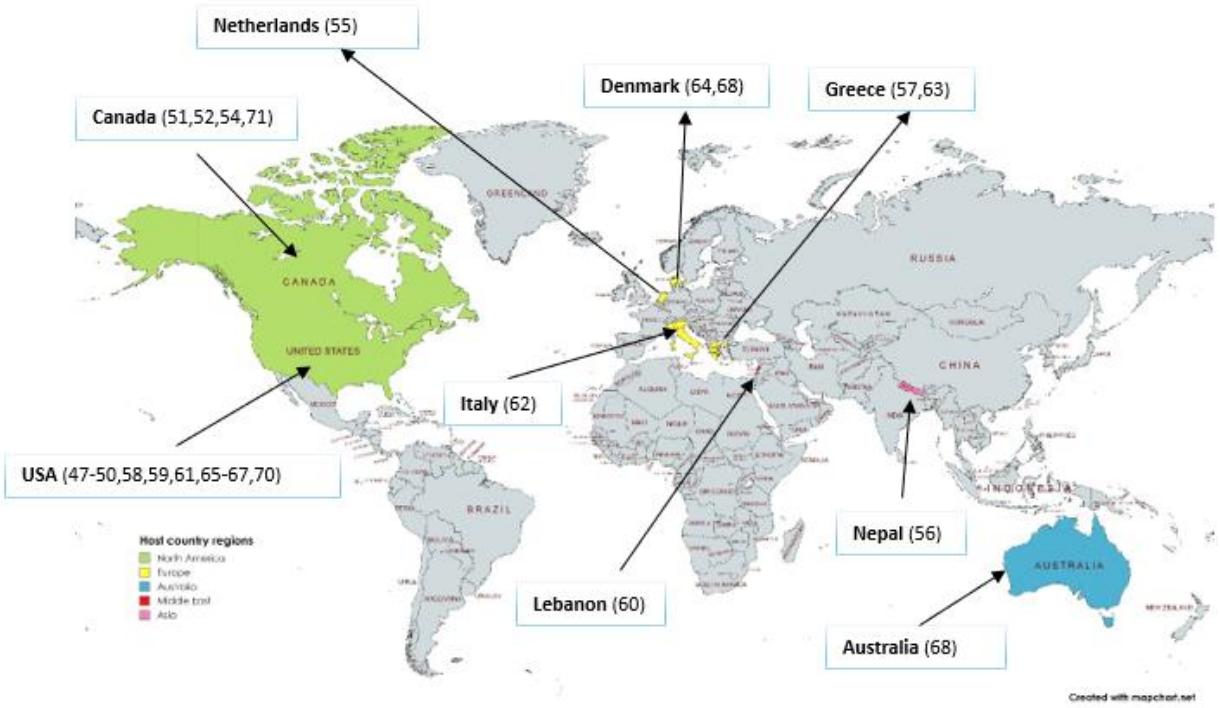


Figure 2. Countries hosting migrants from the 25 included studies (Source, Author)

Health system actors featured in the reviewed studies include parents and guardians (9/25), adolescents (2/25), health providers (1/25) and a broader range of migrants classified as women, who were involved in HPV vaccination decision-making processes (11/25). Mixed samples of adolescents/young adults and caregivers featured in 2/25 studies.

Health system determinants of HPV vaccination service delivery

The WHO building blocks [41] were used to map health system hardware-related determinants of HPV vaccination service delivery. Determinants were grouped into those that enable and those that impede service delivery (Table 4).

Table 4. Health system determinants of HPV vaccination service delivery based on WHO building blocks (Source, Author)

Building Blocks	Enablers (+)	Impediments (-)
1. Leadership/ governance	1.1 policies prioritising migrants' health needs 1.2 decentralised governance and variations in immunisation policy implementation 1.3 governments as gatekeepers in migrant-inclusive immunisation policy implementation	1.1(a) HPV vaccination policies not implemented in some countries 1.2(a) decentralised governance and variations in immunisation policy implementation
2. Service delivery AND Medicines/ Vaccines	2.1 school-based HPV vaccination programs 2.2 supplementary catch-up vaccination 2.3 migrant-targeted interventions 2.4 integrated services 2.5 public-private partnerships	2.1(a) no HPV vaccination program available 2.2(a) HPV vaccination available in NIP but as voluntary routine not mandatory routine vaccination 2.3(a) health messaging targets limited audience 2.4(a) limited access e.g. schools, holding camps, eligibility based on legal status
3. Health workforce	3.1 health provider recommendation 3.2 health provider main source of HPV vaccination-related information 3.3 vaccine administration (including consent)	3.1(a) no health provider recommendation 3.2(a) health provider time constraints – limited time to discuss HPV vaccination 3.3(a) health provider reticence to recommend vaccination 3.4(a) health provider inadequately trained to serve migrant populations
4. Health information systems	4.1 electronic health databases with migrants' records (including immunisation data)	4.1(a) no vaccination records available for migrant populations 4.2(a) no centralised or synchronised electronic databases with migrants' immunisation data
5. Financing	5.1 HPV vaccination free for all (including migrants) via NIPs and other support programs	5.1(a)cost for ineligible, partially covered and uninsured migrants

Leadership and governance-related factors include policies prioritising migrants' health needs, governance systems and the role of governments in vaccination policy immunisation. In Australia, the Queensland government endorsed the Refugee Health and Wellbeing Policy and Action Plan 2017–2020 to specifically address refugees' and asylum seekers' needs [69]. Also noteworthy is the Health Care Consent Act which allows children in Ontario Province, Canada to get HPV vaccination without parental consent [54]. Three notable policy HPV-related adaptations were identified Iin the USA, the first country to introduce primary care-based HPV vaccination in 2006. These adaptations include: (i) an initial attempt at mandatory vaccination for all grade six girls which failed in 2007; (ii) a 2008 directive making HPV vaccination mandatory for all incoming immigrant girls aged 11-26 years, which was vetoed by the National Coalition for Immigrant Women's Rights, causing the government to recant at the end of 2009; and (iii) the current recommendation of free routine HPV vaccination for all (including migrants) aged 11-12 year olds, and as well as catch up vaccination up to 26 years of age [49, 67]. In countries with decentralised governance systems such as Australia, the USA and Canada, variations in policy implementation at federal level may facilitate or impede service delivery at practice level. For instance,

some provinces in Canada offer free HPV catch-up vaccination to all, including migrants, in contrast to provinces where HPV vaccination at own cost applies to individuals deemed ineligible for free publicly funded HPV vaccination services [54].

This links with the WHO financing building block. Free HPV vaccination for all via NIPs and other supporting programs, in countries such as the Netherlands [55], the USA [47, 49, 67] and parts of Canada [51], enables service delivery among involuntary migrants. The cost of HPV vaccines may impede service delivery in contexts were there was either partial or no coverage. For instance, in Denmark free immunisation services (including HPV vaccination) for all eligible legally registered citizens and permanent citizens includes refugees but excludes asylum seekers and other newly arrived migrants whose status is yet to be determined [64], while in Lebanon HPV vaccination is available at own cost [60]. Government endorsed supporting programs such as the Vaccines for Children Program and the Advisory Committee on Immunisation Practices in the USA [49, 65, 67], and the Centre for Infectious Disease Control in the Netherlands [55] serve as implementers of immunisation-related policies and programs.

Service delivery is contingent on availability of HPV vaccination programs and the various modes of implementation of these such programs, which determines whether HPV vaccines reach involuntary migrants. In the WHO European region, 37 out of 53 countries include HPV vaccination in their NIPs [63]. For instance, Greece provides free HPV vaccination through its ministry of health for all 12-16-year-old girls [63]. Lack of HPV vaccination programs in migrants' home countries impedes access to such services as observed among refugees, predominantly from LMICs, resettled in the USA [66] and Syrian refugees resettled in Greece [57]. Modes of HPV vaccination implementation include school-based programs, catch-up vaccination and other migrant-targeted interventions, integrated services and public-private partnerships. In Denmark, HPV vaccination was available at a cost until 2009, when the vaccine was added to the national routine immunisation program for girls and boys aged 12-18 years old, with a supplementary catch-up program at no cost for all registered persons including migrants [64, 68]. In Canada, Saskatchewan Province has a publicly funded, school-based HPV vaccination program for all grade 6 children and catch-up specialised HPV vaccination public health immunisation clinics for all 9-26-year-olds [51]. School-based programs may impede service delivery by limiting HPV vaccine-eligible age groups, for example in the Netherlands where services are limited to 12-year-olds only [55]. Vaccination service delivery may also be impeded by place of residence for example Syrian refugees in Lebanon, most of whom do not reside in refugee camps and thus may miss out on vaccination opportunities [60]. Health-related messaging may also impede vaccination service delivery by targeting a narrow audience such as younger women, instead of women of all age groups, as observed in a study of Somali and Mexican immigrants and refugees based in Ohio, USA [58].

The Refugee Health Assessment Program (RHAP) of Massachusetts Department of Public Health is an example of a US-based intervention specifically targeting involuntary migrants [65], that enables service delivery to this population. Even so, RHAPs are not standardised in the USA so there may be variances in implementation and consequently, RHAP access for migrant populations may vary in different states [65]. Due to ensuing financial crisis in Greece, primary health care is facilitated via public private partnerships between non-governmental organisations (NGOs) and the government, through NGO-run polyclinics which provide free HPV vaccination to all vulnerable populations regardless of legal or other status, including refugees and migrants [63]. In Australia, HPV vaccination in Queensland is offered through the refugee clinic model, a collaborative venture involving the Partnership Advisory Group Queensland, local primary health networks and the Refugee Health Community Advisory Group, comprising health development consultants from different refugee backgrounds

[69]. Another intervention strategy featured in a study of refugees and migrants in Vancouver, Canada and Sydney, Australia is integrating HPV vaccination into the broader range of sexual and reproductive services [53]. However, this study noted that integrated service delivery did not necessarily correlate with improved uptake due to other socio-cultural factors which are discussed in the section on determinants of vaccination uptake.

Routine vaccinations may be categorised as mandatory, such as those required for school admission in countries like Canada [54] and Lebanon [60], or voluntary. This may have implications for service delivery in vaccines, including HPV, which are categorised as routine voluntary vaccines. For instance, in Lebanon, non-mandatory vaccines including HPV are excluded from the Lebanese National Immunisation calendar and only available at one's own cost [60], as different from Greece where all vaccinations are voluntary but available free via the NIP [63]. In certain contexts, the distinction between routine mandatory and voluntary vaccinations may be less apparent, for instance in the USA where HPV vaccination, though voluntary, is included in the RHAP routine immunisation package for all incoming refugees [65]. HPV vaccine service delivery via the RHAP was associated with increased vaccination coverage in Massachusetts where higher uptake of the first HPVV dose was reported among 13-17-year-old refugees (68%) compared to adolescents of the same age in the general population (45%) [65].

Within the health workforce, it is worth noting the role of health providers as gatekeepers in enabling HPV vaccination by recommending the vaccine and as the main sources of HPV vaccination-related information, as reiterated in several studies, including some of refugees resettle in USA [48-50] and a group of refugees and migrants in Italy [62]. Health providers also play key roles in administering the HPV vaccine, including obtaining informed consent from parents and guardians of minors as documented in a Canadian study [51]. A sequel of two included articles that form part of the same Canadian-based study suggested two possible reasons for lack of vaccine recommendations by health providers, which may impede service delivery. First, health providers were often too busy to discuss and recommend HPV vaccination to newly resettled migrants, a view shared by both patients (recent migrants) and health professionals [54, 71]. Health professionals clarified that in their immunisation-related conversations, precedence was given to routine mandatory vaccinations required for school entry at the expense of non-mandatory vaccines such as HPV [54]. The second reason given for health professionals' reticence to recommend HPV vaccination to new migrants was the perception that the cost of CAD 540 was prohibitive for those not eligible for publicly funded HPV vaccination and those without health insurance [54]. Further to this, a study conducted in Denmark also noted that health professionals were typically ill-prepared to serve migrants, underscoring the need for health professionals to be cognisant of the heightened risk of non-immunisation among certain migrant sub-populations such as refugees [68].

Health information systems in the form of electronic records featured in five of the articles reviewed. These studies underscored the need to mobilise resources by synchronising immunisation data for quality service delivery as well as production of data that may be used in research aimed at informing immunisation policy and practice. Establishing the immunisation status of Syrian refugees residing in Lebanon proved problematic in the absence of electronic health records for children who had no documentation of prior and/or current immunisation and where parental recall of children's immunisation status was hampered by low literacy levels [60]. Health providers of recently arrived immigrants in Canada recommended a centralised electronic vaccination database for easy access to migrants' records, to avoid both over- and under immunisation [54]. Further, the health providers advocated for incorporation of digital technology such as mobile phones for disseminating HPV vaccination reminders in different languages to migrants [54]. In Australia, Denmark, and the USA, electronic health records enabled retrospective cohort studies to investigate HPV vaccination among

various migrant populations [64, 67, 69]. In Denmark, the Danish National Health Register maintains national records of all public healthcare services that utilise government revenue [64]. In Nebraska, USA, electronic medical records exist with refugee health data, captured upon entry and updated post-entry, and this proved useful in examining determinants of HPV vaccination among Burmese refugee girls resettled in Nebraska [67]. In Queensland, Australia data from an electronic health database was utilised to determine catch-up vaccination processes and determinants of under-immunisation among refugees resettled in East Queensland [69].

Health system determinants of HPV vaccination uptake

The 5As framework [39] was utilised to explore health system software-related determinants of HPV vaccination uptake (Table 5).

Table 5. Summary of health system determinants of HPV vaccination uptake featured, based on 5As Framework (Source, Author)

Determinants of uptake (5As)	Enablers (+)	Impediments (-)
1. Access	1.1 easy access/convenience	1.1(a) legal status
	1.2 navigating language barriers	1.2(a) unfamiliarity with host country's health care system
		1.3(a) language barriers
2. Affordability	2.1 free vaccination	2.1(a) cost prohibitive
	2.2 willingness to vaccinate	
3. Awareness and Acceptance	3.1 adequate knowledge about HPV vaccination: ▪ culturally appropriate health promotion materials and forums ▪ information sources	3.1(a) low/lack of knowledge about HPV vaccination: ▪ language barriers ▪ misinformation ▪ mistrust of governments' intentions ▪ living conditions
	3.2 framing/perception of HPV vaccination: ▪ protective and/or preventive ▪ a western disease	3.2(a) concerns about long term effects and effectiveness of vaccine
	3.3 length of stay in host country	3.3(a) length of stay in host country
		3.4(a) sociocultural and religious attitudes, beliefs and practices ▪ sex deemed a taboo topic ▪ allowing HPV vaccination is endorsing pre-marital sex and promiscuity ▪ young girls are not sexually active ▪ preference for traditional medicine
4. Activation	4.1 health provider recommendation	4.1(a) health provider reticence to recommend HPV vaccination
	4.2 women's agency and family support	4.2(a) mothers' disapproval
	4.4 assumption that HPV vaccination is compulsory	4.4(a) preventive care not prioritised
	4.5 incentives	

Ease of access enables vaccine uptake for instance, targeted interventions such as refugee health programs at point of entry in USA [65, 67] and polyclinics catering for vulnerable persons regardless of legal status in Greece [63], which provided easily accessible and convenient access to health services (including HPV vaccination) for migrant populations. Sometimes, legal status is a barrier in accessing care as observed in Denmark where

asylum seekers whose legal status is yet to be determined are not eligible for preventive care services, including HPV vaccination [64]. A common sentiment is that language barriers may impede access to available information via print and other media, for example, among migrants in USA and Canada, where HPV-related information materials in English deterred access to those not proficient in the language [50, 51]. When linguistic barriers impeded access to available information, some migrant parents relied on their children's knowledge and understanding of HPV-related information to guide decision-making, for example, USA-based refugees from Cambodia, sub-Saharan Africa and the Middle East [50, 61], and the Netherlands [55]. Among a sample of Syrian refugees residing in Greece, about one third of refugees in one study explained that they would not know where to locate a doctor if they needed healthcare due to unfamiliarity with Greek language [57]. Navigating unfamiliar healthcare systems in host countries, which was compounded by language barriers, also impeded migrants' access to HPV vaccination as observed in a study of Cambodian refugees resettled in USA [49].

Affordability is linked with access given that cost may either enable or impede access to and consequently, uptake of vaccination services. Approximately 92% of a sample of Bhutanese refugees in Nepal indicated willingness for their daughters to receive HPV vaccination if it was free [56], while close to 60% of a sample of unvaccinated refugee and migrant women in Ohio, USA indicated willingness to get vaccinated if the HPV vaccine was offered free or at a reduced cost [58]. A contrasting view was documented in a Canadian study of newcomer migrants, some of whom were willing to pay for HPV vaccination in instances where they were ineligible for free vaccines [71]. In this regard, willingness to vaccinate was determined by whether the vaccine was available free or at a fee. Willingness to vaccinate may also be considered an indicator of acceptance.

Awareness and acceptance, both closely intertwined, were the most identified determinants of HPV vaccination uptake. On one hand, a study on HPV vaccination among American Cambodian teenagers, of whom 70% were refugees and migrants, showed her odds of HPV vaccination (OR = 4.08; 95% CI: 1.50–11.05) among daughters of mothers who were knowledgeable about HPV [61]. On the other hand, despite HPV vaccination being freely available in Italy, 44% of migrants and refugees in one study acknowledged not being aware of such services [62]. Similarly, a qualitative study exploring cervical cancer screening and prevention practices of refugee women in San Diego, California observed that though HPV vaccines are freely available, 17 of the 18 women interviewed were not aware of the vaccine and none of their children were vaccinated [50]. Lack of awareness may hinder vaccine acceptance and uptake. Low risk perception due to limited HPV-related awareness was associated with low HPV vaccination uptake among immigrant and refugee catch-up groups in a Canadian Province [52]. In addition to low awareness, Bhutanese refugee women's health and wellbeing was shaped by social determinants, linked to prolonged residence in refugee camps, which increased their risk of HPV infection and cervical cancer; early sexual debut, multiple partners and marriages, alcohol use and smoking [56].

Culturally appropriate packaging of health information is also a determinant of awareness and acceptance, as observed among a sample of Somali refugees resettled in the Netherlands who preferred oral communication in their home language to printed information in English or Dutch [55]. The use of visual health information messages to bridge language gaps was recommended in a study of USA-based refugees from sub-Saharan Africa and the Middle East [50]. In certain instances, misinformation was circulated via informal sources of information such as interpersonal networks comprising family and friends, and the media (including social media). For instance, media sources yielded amorphous information on HPV vaccination among a sample of USA-based migrants and refugees [70]. Reliance on (mis)information sharing via interpersonal lay networks,

among a sample of migrant and refugee women in Australia and Canada, led to the belief that HPV vaccination causes cancer [53], while others in the USA thought that HPV infections occurred due to poor hygiene and consuming spoiled food in refugee camps [61]. Misinformation may hinder acceptance. Culturally appropriate packaging of health information includes consideration of the forums where such information is disseminated, suggesting a shift from health facilities to community-based spaces tailored to linguistic and cultural specifications, as exemplified in a USA-based and a Canadian study [51, 61].

The framing of HPV-related messages may also influence acceptance and uptake of HPV vaccination. Among USA-based Cambodian refugee mothers, framing HPV vaccination as protective enabled acceptance because it is consistent with the historical/political narrative of mothers protecting daughters from harm during the Khmer Rouge genocide in Cambodia (1975-1979), and subsequent forced migration to refugee camps in Thailand, before eventually being resettled in the USA [49]. The belief that cervical cancer is a 'western' disease may facilitate HPV vaccine uptake by increasing perceived risk among resettled refugees. This was observed in a study of sub-Saharan African and Middle Eastern refugees resettled in the USA [50]. Likewise, the perception of HPV vaccine as: (i) protection from cervical cancer and (ii) like other routine vaccinations promoted acceptance among some Somali refugee women in the Netherlands [55]. Even so, mistrust in government intentions, linked to war-related experiences, hindered acceptance was observed among this group of Somali refugee women, some of whom expressed fear and misconceptions of being experimental objects to monitor long-term effects of HPV vaccination [55]. Acceptance among some migrant groups was impeded by concerns about the long-term effects of the vaccine and whether it was effective in curbing HPV infections [47, 60].

Links were posited between migrants' duration of stay in host countries and increased uptake of HPV vaccination. Higher uptake, attributed to acculturation, was observed in a qualitative study of refugees and migrants who had lived in Canada for over five years compared to those who had been in Canada for less than five years [52]. In Denmark, longer duration of stay and higher parental education were linked to higher odds of HPV vaccination among Asian, Bosnia-Herzegovina and Stateless Palestinian refugee girls compared to local Danish girls [68]. A contrasting trend was observed in Queensland Australia where refugees and asylum seekers who arrived in Australia prior to 2010 were more likely to be under-immunised compared to their recently resettled counterparts [69]. A possible explanation for this variance is the likelihood that uptake may have increased after Queensland Government endorsed the Refugee Health and Wellbeing Policy and Action Plan (2017-2020) [69]. Prevailing socio-cultural and religious attitudes and beliefs hindered awareness and acceptance of HPV vaccination in some migrant communities. These include cultural taboos prohibiting sex-related conversations between parents and daughters, conflation of HPV vaccination with endorsing pre-marital sex in cultures where girls' virginity is lauded as virtuous, fear of the vaccine causing infertility and fear of ostracization of errant girls reported among involuntary migrants residing in the Netherlands and Canada [54, 55]. Three studies observed that the belief that their daughters were too young to be sexually active and consequently, low perceived risk of HPV infection impeded migrant parents' acceptance of the vaccine [51, 55, 60].

The significant role of recommendations by health professionals in facilitating activation, in the sense of positively influencing caregivers' intent to vaccinate their children and/or nudging them to vaccinate their children, was a recurring theme. The high likelihood of heeding to health professionals' recommendations was linked to trust in the health care system and health professionals involved in service delivery therein. This was reported in studies conducted among involuntary migrants resettled in the USA [49, 50, 67] and among mixed groups of voluntary and involuntary migrants resettled in Canada [52, 54, 71]. In a qualitative study of

facilitators and barriers to cervical cancer screening and HPV vaccination, 27 out of 31 women ranked doctors' recommendation as the top activation factor regarding influencing decisions to vaccinate their children [48]. Where there was a lack of health provider recommendation, this was identified as a barrier to uptake of HPV vaccination as demonstrated among a small sample of Cambodian teenage refugees residing in the USA [61]. Despite the Health Care Consent Act which permits adolescents in Ontario to obtain HPV vaccination without parental consent, health providers were reticent to vaccinate adolescents due to the possibility that parents may not approve of this [54], which may deter willing adolescents from receiving the vaccine. The role of family support, and particularly in patriarchal contexts, featured in two studies, one in which women refugees noted the supportive role of their husbands in HPV vaccination-related decision-making for their children [48]. The other study mentioned gender-related diminished agency and freedom, linked to patriarchy, as the context in which refugees and migrants navigate sexual and reproductive health-related issues, including HPV vaccination [53]. In contrast, refugee mothers' disapproval of HPV vaccination in the Netherlands influenced rejection of the vaccine by their daughters [55], implying a sense of agency among these mothers. The same study mentioned that some refugee women thought HPV vaccination was compulsory in which case compliance may activate vaccination [55].

Activation may also be impeded by under-prioritisation of preventive care. It worth noting is how the lack of preventive care services (e.g. HPV vaccination) in migrants' home countries could contribute to under-prioritisation of preventive care among migrants themselves post-resettlement, as observed in a study of refugee women in USA and another on refugee and migrant women in Canada and Australia [50, 53]. Under-prioritisation also featured in a study of USA-based Cambodian mothers which alluded to the possibility that survival instinct, associated with forced displacement and resettlement, may lead to under-prioritisation of preventive health services such as HPV vaccination [49]. In this study, under-prioritisation of preventive care was implied in some refugee women's view that it was unnecessary to fix non-existent problems [49]. The use of incentives in facilitating activation was mentioned in the 'no jab no pay' policy implemented in Queensland Australia in 2016, through which government incentives including childcare and family tax benefits were offered to parents of fully immunised children as per the NIP schedule or an accepted catch-up schedule [69]. This policy resulted in a marked increase in full immunisation and a decrease in under-immunisation, which may positively impact HPV vaccination particularly in Queensland where it is one of the immunisations with the lowest uptake among refugees and asylum seekers [69].

Health system performance indicators and reported considerations for migrant-inclusive HPV vaccination services

Indicators of robust health systems contained in Witter et al. Health System Strengthening Framework [42] were mapped alongside practice, provider and patient-level influences of the P3 Model [38] and determinants of HPV vaccination delivery and uptake to illustrate the complex, dynamic, interdependent relationships and consequent health outcomes among the various health system components (Table 6).

Table 6. Health system performance indicators, influences and determinants of HPV vaccination (Source, Author)

Health system performance indicators	Practice-level influences	Provider-level influences	Patient-level influences	WHO building blocks/delivery determinants	5As of uptake
Equity	Delivery: *enabler* - policy adaptation and implementation to include migrants	Delivery*: enabler* - policy implementation to include migrants *impediment* - differential implementation (exclusion of certain migrant sub-populations)	Uptake: *enabler* - easy, convenient, free access i*mpediments* – access contingent on legal status, language, knowledge/awareness-related barriers	Leadership/ governance/ policy	Access Affordability
Quality	Delivery: *enabler* - updated, synchronised electronic health databases with migrants' immunisation records *impediment* – no records of migrant immunisation data	Delivery: *enablers* – public private partnerships *impediments* – health provider time constraints, limited/lack of training, reticence to recommend HPV vaccine	Delivery: *impediments* – no records of migrant immunisation data (could result in under- and/or over-immunisation)	Health information systems Service delivery Medicines/vaccines	Access Awareness
Resource mobilisation	Delivery: *enablers* – school-based programs, supplementary catch-up, migrant-specific interventions, integrated services	Delivery: *enablers* – school-based programs, supplementary catch-up, migrant-specific interventions, integrated services	Delivery: *enablers* – school-based programs, supplementary catch-up, migrant-specific interventions, integrated services	Service delivery Medicines/ vaccines	Access
High immunisation coverage	Delivery: *enablers* – public private partnerships Uptake: *enablers* – culturally appropriate health messaging	Delivery: *enablers* – public private partnerships, health provider recommendations; i*mpediments* – no health provider recommendation	Uptake: *enablers* - easy, convenient, free access, health provider recommendation, incentives *impediments* – difficult to access, socio-cultural beliefs	Service delivery Medicines/vaccines Health workforce	Access Awareness Acceptance Activation
Social/financial risk protection	Delivery & uptake: *enabler* – free HPV vaccine regardless of legal status *impediment*– HPV vaccine cost partially covered or at own cost	Delivery & uptake: *enabler* – free HPV vaccine regardless of legal status *impediment* – HPV vaccine cost partially covered or at own cost	Delivery & uptake: *enabler* – free HPV vaccine regardless of legal status *impediment* – HPV vaccine cost partially covered or at own cost	Health financing	Affordability Access Awareness
Responsiveness	Delivery: *impediment* – health promotion materials in English are not understood	Uptake: *enablers* – health provider recommendations, framing HPV vaccination as protective *impediments* – no health provider recommendation, limited/lack of training, reticence to recommend HPV vaccine	Uptake: *enablers* – health provider recommendations, framing HPV vaccination as protective Uptake: *impediments* – language barriers, mistrust of host country governments, misinformation, no health provider recommendation, under-prioritisation of preventive care	Service delivery	Access Awareness Acceptance Activation

Equity featured in the context of leadership and governance, specifically in policy adaptation and implementation to facilitate inclusion of migrants. At practice level, inclusion of migrants in NIPs in several countries is evidence of progress towards equitable service delivery to immunisation services. At provider level, variances in policy implementation have resulted in persistent inequity in access to immunisation services among certain sub-populations of migrants such as involuntary migrants whose access to vaccination services may be dependent on one's legal status in the host country of residence, for instance in asylum seekers in Denmark [64]. At patient level, equity translates to if and how readily migrant populations can access HPV vaccination and the affordability of these services, which determines uptake. Equity is a central thread interweaved across other performance indicators in the sense that quality, resource mobilisation, high immunisation coverage, social and financial risk protection and responsiveness are all contingent on equitable service delivery and uptake.

Quality indicators evident in HPV vaccination service delivery at practice and patient levels include updated and synchronised electronic health databases with migrants' immunisation records, which were not available in many countries despite the absence of records being a commonly shared concern raised by host countries, including Canada [54] and Lebanon [60]. The absence of accurate records may result in under- and/or -over-immunisation, as observed in a Canadian study [54] and consequently, increased risk of VPDs among the under-immunised and wastage of resources in the case of over-immunisation. At provider level, public private partnerships between governments and NGOs may boost quality by enhancing service delivery and consolidating resources (Table 6), as demonstrated by the polyclinics model in Greece [63] and the refugee clinic model in Queensland, Australia [69].

Resource mobilisation is exemplified in the various HPV vaccination programs available and how these pan out at practice, provider and patient levels. These include school-based programs, the most utilised avenue for HPV vaccination and supplementary catch-up vaccination. Facility-based programs are relatively widely available in most host countries including the USA [49, 67], Denmark [64, 68], Greece [63] and Australia [69], while Canada offers both school-based and facility-based HPV vaccination programs. In contrast catch-up vaccination is available in fewer countries such as Australia [69], Canada [51, 52] and Denmark [64, 68]. Sometimes certain sub-populations of migrants are ineligible for free catch-up vaccination for instance refugees and migrants aged 16-27 years old in Ontario, Canada [71].

High immunisation coverage is contingent on achieving equity, quality, resource mobilisation, social/financial risk protection and responsiveness goals at practice, provider and patient levels. Likewise, social and financial risk protection, which is linked with health financing, is contingent on achieving equity and responsiveness goals at practice, provider and patient levels.

Responsiveness occurs in the context of interactions among health system actors including health providers, policymakers, individual patients, families and communities. During these interactions, needs and expectations are indicators of responsiveness in as far as whether the health system meets the expectations of migrant populations. At practice and patient levels, health information materials produced in languages that are unfamiliar to migrants impede HPV vaccination service delivery and uptake as addressed previously (Table 5). At patient-level, this is exacerbated by misinformation circulated via interpersonal networks, with a negative ripple effect access, awareness, acceptance and activation as observed among migrant and refugee women in Australia and Canada [53], and the USA [61]. At provider and practice levels, health provider recommendations are an exemplar of responsiveness to migrants' need for HPV endorsement from trusted sources, which is likely to increase uptake and conversely, decrease uptake if health providers fail to recommend the vaccine to

migrants (Table 5). At patient level, two additional responsiveness-related impediments are mistrust of host-country governments, for example among Somali refugee women in the Netherlands [55], and under-prioritisation of preventive care which may be partially attributed to experiences in home countries and/or migration experiences, as exemplified among a group of USA-based refugee women [50] and a group of refugee and migrant women residing in Canada and Australia [53].

Discussion

This review demonstrates efforts to include involuntary migrants in NIPs through policy adaptation at regional and national levels and by working to ensure access to immunisation for all, including involuntary migrant populations who are deemed vulnerable [32]. To the best of our knowledge, this is one of the first comprehensive systematic reviews that has focused on involuntary migrants and their experiences with HPV vaccination. This adds to the strong body of evidence on the importance of HPV vaccination for all migrant populations regardless of who they are, where they reside and their legal status. Two previous reviews studied determinants of HPV vaccination among migrants as a homogenous group [72, 73], while a third review examined health system determinants of HPV and MMR vaccination among disadvantaged, minority or underserved populations [74]. One of these three reviews took note of the varied terms used to describe migrants and acknowledged that in focusing on diverse sub-populations of migrants, one could miss out on nuances akin to specific sub-populations [70].

There were significantly fewer studies from LMICs compared to HICs. This reiterates the findings of recent reviews addressing HPV vaccination among migrant populations in which the evidence was largely from HICs but based on migrant populations from LMICs [72-74]. A plausible reason for this disparity is that there has been slower adoption of HPV vaccine to routine programs in LMICs compared HICs for various reasons, including financial constraints, health system barriers, technical limitations and performance gaps between first and second dose completion, with high dropout rates in the latter [2, 9, 13]. This comparatively slower adoption may partially account for the dearth of publications on HPV vaccination among migrant populations in LMICs. Notwithstanding, our findings suggest that there is still an argument to be made for understanding HPV vaccination-related needs of involuntary migrant populations living in LMICs. For instance, Nepal-based Bhutanese refugee women's knowledge of HPV as a cause of cervical cancer and awareness of HPV vaccination was much lower than that of local Nepalese women residing in the same district [56]. The situation was further compounded by other social determinants such as early marriage and sexual debut, multiple partners and marriages, which placed them at higher risk of HPV infection and cervical cancer compared to their Nepalese counterparts [56]. In Lebanon, low uptake (1.5%) of HPV vaccination among Syrian refugee girls was associated with low HPV vaccine-related knowledge among mothers [60]. We propose that more studies be conducted among involuntary migrant populations living in LMICs contexts given that this is where most are hosted.

Key findings from this review, that seem apparent in different kinds of health system settings, include common access-related barriers related legal status and lack of clear policies, awareness-related barriers linked to communication challenges akin to language, literacy and culturally appropriate health messaging, and acceptance-related barriers associated with sociocultural attitudes, beliefs and practices coupled with misinformation and distrust of host country governments, health systems and health providers. These findings are not limited to barriers to HPV vaccination among involuntary migrants but cut across a broad range of routine vaccines including measles-mumps-rubella, diphtheria-pertussis-tetanus, poliomyelitis, pneumococcal disease, Haemophilus influenzae type b, and hepatitis B and COVID-19 [18, 20, 21, 75-78] and across lifespan, including childhood and adolescence [18, 75-78], and adulthood [20, 21]. Further, the mentioned barriers to

vaccination were reported among mixed sub-populations of migrants [20, 21, 77, 78] and specifically among involuntary migrants [18, 75, 76], which renders HPV a relevant proxy for examining the determinants of vaccination delivery and uptake among migrant populations and sub-populations.

Among involuntary migrant populations, the role of sociocultural norms, beliefs and practices as protective factors emerged as key influencers of HPV vaccination uptake. On one hand, framing HPV vaccine as protective encouraged refugee mothers to vaccinate their daughters, as demonstrated in the case of Cambodian refugees resettled in the USA, because this narrative is consistent with the socio-political and historical context of protecting their children during war [49]. On the other hand, sociocultural norms deemed protective, for instance abstinence from pre-marital sex, were associated with reticence to accept HPV vaccination among involuntary migrant parents, caregivers and guardians of adolescent girls [47, 55, 59]. Tankwanchi, et al. review on vaccine hesitancy among migrant communities [27] elucidates the link between sociocultural factors and HPV vaccine uptake among migrants. Based in the 3Cs of vaccine hesitancy (complacency, confidence and convenience) [79]. Tankwanchi et al. explain complacency in terms of low perceived risk of disease, attributed to the protective role of migrants' sociocultural attitudes and beliefs, culminating in refusal or delays in accepting and receiving the vaccine [27].

Our specific focus was involuntary migrants. Despite some similarities between the experiences of migrant populations as a collective and those of involuntary migrants a sub-population, factors related to the disruptive and traumatic context of forced migration present some unique challenges to HPV vaccination delivery and uptake among involuntary migrants. These include sudden forced displacement, damage to healthcare infrastructure and unavailability of health professionals during conflict and other humanitarian emergencies resulting in missed vaccination opportunities, loss and/or damage to vaccination records and increased risk of VPD outbreaks in holding camps [18, 75, 80, 81]. Against this background, three key determinants of vaccination among involuntary migrants relating to equity, resource mobilisation, and responsiveness emerged from our study and are reiterated in extant literature.

(In)equity in access to HPV vaccination featured among involuntary migrants. For instance, in Lebanon where the HPV vaccine is not available free via routine NIPs in the public sector, the out-of-pocket cost of obtaining the vaccine from the private health sector deterred Syrian refugees from accessing HPV vaccination [60]. In this regard, routinisation of HPV vaccines may enhance access by making these vaccines available at no or low cost to this population. Despite free HPV vaccine availability, lower HPV vaccination rates among involuntary migrants from LMICs settled the USA relative to the local population in host countries [50, 61] - attributed to limited/lack of knowledge - points to structural inequity. Structural inequity faced by involuntary migrants resurfaced during COVID-19 in the context of human rights-related access barriers, including failure to prioritise vaccination of involuntary migrants, imposition of legal barriers and fear of being caught, leading to avoidance of healthcare facilities and anti-migrant discrimination [26, 82]. In two instances in the USA, where specific policies and strategies facilitated equitable access to health services by involuntary migrants, higher uptake of the first dose of HPV vaccine was reported among involuntary migrants compared to the general population in Nebraska and Massachusetts [65, 67], underscoring the significance of equity in HPV vaccination access.

Resource mobilisation has successfully been applied in integration of vaccination services with other services, including integrating childhood immunisation and nutritional services [83], child immunisation with maternal preventive health services and HPV vaccination with sexual and reproductive health services [84], during humanitarian emergencies. Integrated interventions may also contribute to improving the quality of services.

Resource mobilisation also includes catering for missed vaccination opportunities by offering supplementary catch-up vaccination, which has featured more in routine childhood vaccination among involuntary migrants [18] than in HPV vaccination, where catch-up services are only available at no cost in some HICs.

Applying a health systems lens allowed for exploration of health system responsiveness [85], by showcasing how NIPs have adapted their vaccination policies to include migrants, highlighting the needs and expectations of migrant populations and further, how health systems have responded to migrants' needs and how this has shaped vaccine uptake. In this regard, a health systems' perspective was beneficial in demonstrating the role of various health system components in facilitating and boosting vaccine delivery and uptake in this population [86, 87]. Vaccination also emerged as a potential avenue for health systems strengthening in the context of vaccination-related policies and interventions that cut across building blocks, which mutually influence each other over time, as indicators of strong health systems [42, 88]. Responsiveness may be a challenge at provider level in situations health infrastructure is damaged and health professionals may be unavailable to deal with preventive services, which may impede sharing of health-related messages.

Recommendations

Our findings have important implications for key actors working in the immunisation, health systems and migrant health space. These may be considered across demand and supply side. Several actors need to be held accountable in both demand and supply spaces. We highlight recommendations for research, policy and practice for four key health system actors: involuntary migrants and community leaders, on the demand side and policy makers and health professionals, on the supply side. A summary of these recommendations is presented in Figure 3.

On the demand side, we recommend involvement of involuntary migrants and community leaders, including those in LMICs, in research to better understand their needs and existing gaps, in addition to research targeting infodemics to counter HPV vaccine-related misinformation. At policy level, inclusion of involuntary migrants in policy formulation and involving community leaders in HPV vaccination-related policy implementation will aid in amplifying their voices in vaccination-related agenda setting and execution. At practice level, specific attention should be directed toward alleviating communication barriers among involuntary migrants, coupled with targeted interventions to enhance knowledge and awareness and ultimately, to secure buy-in of HPV vaccination influencers including parents and guardians. The gatekeeper and liaison roles of community leaders should be leveraged for building trust and facilitation of training in community vaccine advocacy.

On the supply side, policy makers should conduct more policy-relevant research at macro-, meso- and micro-levels to inform involuntary migrant-inclusive HPV vaccination services. Further, there is need for more research exploring health professionals' experiences of delivering HPV vaccination services to involuntary migrant populations. At policy level, we recommend that policy makers prioritise preventive care and involuntary migrant-targeted interventions such as catch-up HPV vaccination. Policy makers have a critical role to play in adapting existing immunisation policies, to ensure that none are inadvertently excluded from accessing HPV vaccination services either on legal or financial grounds. At policy level, health professionals should prioritise delivery of migrant-centric HPV vaccination services, which necessitates training in migrant-sensitive immunisation service delivery. At practice level, there is need for concerted effort among policy makers and health professionals to bridge HPV vaccination service delivery gaps through strategies such as encouraging public-private partnerships by policy makers and appropriate integration of HPV vaccination with primary healthcare services for migrant populations by health professionals.

Limitations

Majority of the studies sampled (23/25) were from the experiences of migrants resettled in HICs where most HPV vaccination programs are concentrated, as noted in several studies [9, 13, 72, 89], thus may not be fully representative of LMIC contexts. Even so, evidence from HICs may be useful in: (i) understanding immunisation contexts in LMICs, which are the home countries to a large population of migrants resettled in HICs (ii) informing immunisation policies for migrant populations in high-income and other contexts, particularly LMICs where close to 76% of forcibly displaced migrants reside [29]. Further focusing solely on HPV vaccination was topically limited. However, in the context of qualitative evidence synthesis coupled with an analytical model comprising four frameworks, the detailed narrative data provided sufficient data for analysis leading to the results presented.

Conclusion

Prioritising vaccination programs linked with non-outbreak related childhood and adolescent diseases is challenging in the context of humanitarian crises given fragile health systems, limited resources, loss of health infrastructure, deployment of health staff to respond to emergency health issues, all of which sideline preventative services like HPV vaccination programs. The implication is that relevant actors at all levels of the health system will need to carefully consider trade-offs while ensuring that involuntary migrant adolescent girls living in these contexts or resettled in host countries are not left at risk of developing cervical cancer.

Author contributions

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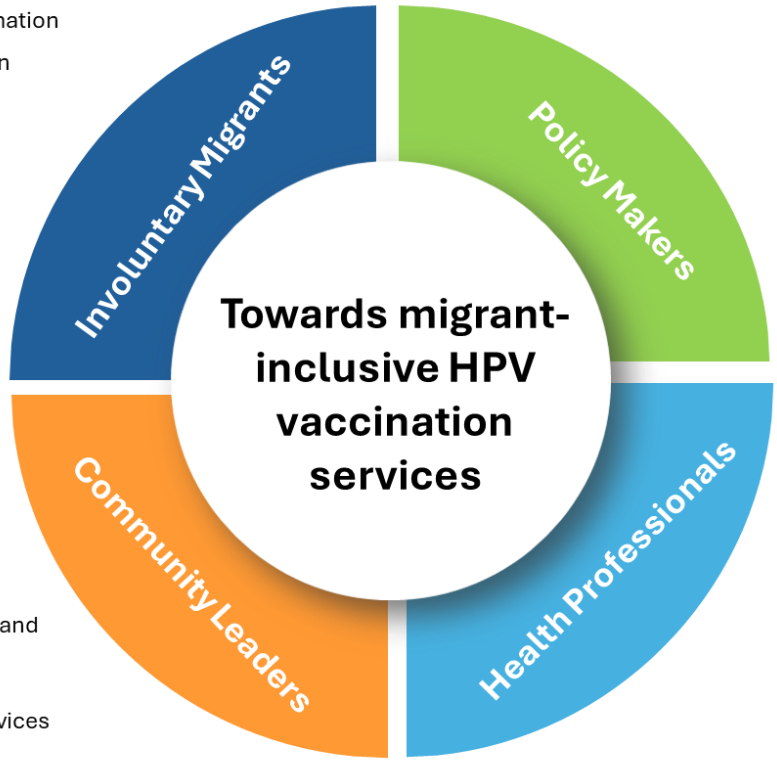
Demand-side Recommendations

Involuntary Migrants

- ❑ Involve LMIC-based migrants in research
- ❑ Infodemics research to counter misinformation
- ❑ Amplify migrant voice in policy formulation
- ❑ Culturally sensitive health messaging
- ❑ Educational interventions to enhance knowledge
- ❑ Appropriate message framing to enhance acceptability and uptake
- ❑ Targeted interventions for vaccination influencers (e.g. parents/caregivers)

Community Leaders

- ❑ Participatory action research to facilitate stakeholder input
- ❑ Involvement in immunisation policy implementation endeavours
- ❑ Leverage gatekeeper role in building trust and securing community buy-in
- ❑ Training in community vaccine advocacy
- ❑ Leverage liaison role to expand health services to communities



Supply-side Recommendations

Policy Makers

- ❑ Research to inform migrant-inclusive HPV vaccination services
- ❑ Prioritise and align preventive care in home and host countries
- ❑ Commission migrant-targeted policy interventions
- ❑ Adapt existing immunisation policies to enhance migrant inclusiveness
- ❑ Centralised electronic health records accessible in home and host countries
- ❑ Encourage public-private/NGO partnerships to improve vaccine service delivery

Health Professionals

- ❑ Research on HCWs experiences of delivering HPV vaccination services to involuntary migrant populations
- ❑ Prioritise delivery of migrant-centric HPV vaccination services in home and host countries
- ❑ Enhance adherence to HPV vaccination policy guidelines targeting migrant populations
- ❑ Training on migrant-sensitive immunisation service delivery
- ❑ Establish a culture of recommending HPV vaccines
- ❑ Appropriate integration of HPV vaccination into primary healthcare services for migrant populations

❑ *Research Recommendations* ❑ *Policy Recommendations* ❑ *Practice Recommendations*

Figure 3: Recommendations for key health systems actors (Source, Author)

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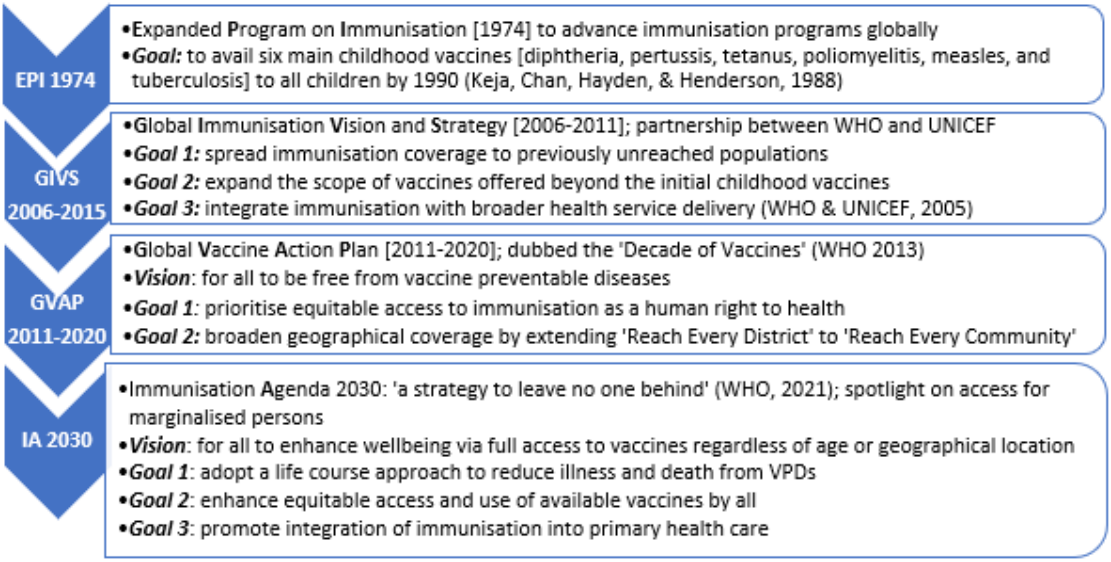
Appendix A. Research protocol: routine childhood and adolescent immunisation among migrant populations

Introduction

Immunisation has proven to be a powerful and cost-effective public health intervention that has significantly reduced global morbidity and mortality from vaccine preventable diseases (VPDs) worldwide. During the era of the Global Vaccine Action Plan (2011-2020), immunisation was estimated to have averted close to 2.5 million deaths annually by 2013 with measles vaccination alone preventing 23 million deaths globally between 2010 and 2018 [1]. Currently, vaccines are available for prevention of 20 potentially fatal illnesses, with more vaccine candidates undergoing pre-clinical and clinical trials [2]. Four global immunisation strategy goals demonstrate concerted and progressive effort towards improving access, coverage, and delivery of immunisation services worldwide and ultimately, progress towards achieving the Sustainable Development Goals (SDGs) and Universal Health Coverage. These are the Expanded Programme on Immunisation [3], the Global Immunisation Vision and Strategy [4], the Global Vaccine Action Plan [1] and the Immunisation Agenda 2030 [2] (Fig 1).



EPI – Expanded Program on Immunisation; GIVS – Global Immunisation Vision and Strategy; GVAP – Global Vaccine Action Plan; IA 2030 – Immunisation Agenda 2030

Fig 1. Key global immunisation polices and goals (Source, Author)

Despite the progress in access to immunisation services coupled with the development of new and improved vaccines, several challenges persist in controlling the burden of VPDs. First, inequitable access to new vaccines is evident between high-income countries (HICs) and low-and-middle-income countries (LMICs). For example, in 2010 13% of children in HICs had no access to pneumococcal conjugate vaccines via their national immunisation programmes compared to 98% in LMICs [1]. Second, in some instances, progress in vaccine coverage has stalled or been reversed because of trends such as vaccine hesitancy, which has led to calls to intensify advocacy to increase public knowledge about the relevance of vaccination [2, 5]. Third, monitoring of vaccination coverage and disease surveillance systems are not updated regularly and are not adequately synchronised with other health information systems [5], which may potentially impact prioritisation and reporting, with a knock-on effect on service provision. Fourth, in some LMIC contexts where there are large indigent populations with limited to no health insurance, vaccination-related out-of-pocket expenditure could

further jeopardise household income and deter utilisation of vaccination services [2]. The fifth challenge relates to uneven vaccination coverage and fragmented distribution of immunisation services, particularly among hard-to-reach, marginalised populations such as indigent persons, migrant populations and other categories of persons deemed vulnerable, who are oftentimes excluded from accessing lifesaving immunisation services [6]. This is a priority public health concern given that VPDs persist and continue to be a major cause of morbidity and mortality, particularly among marginalised, hard-to-reach populations and in resource-limited contexts within LMICs, where sub-optimal vaccination coverage and under-immunisation remain prevalent [1, 2].

Migrants are considered a vulnerable population group because of their unique positioning at the nexus of three global health threats namely climate change, conflict, and pandemics.[3] That is, migrations may commonly occur as an adaptative response to climate change-related disasters (flooding and drought), as a response to conflict and attendant instability, and/or in the context of pandemics or disease outbreaks, as well as a host of other reasons such as economic conditions [7-9]. Mobility renders migrant populations more vulnerable in several ways. It may limit their access to preventative health services which leaves them susceptible to infections and potentially resulting in VPD outbreaks. Further to this, mobility could foster disease transmission in the process of movement from one location to another. While in transit from their home countries, migrants may miss opportunities for vaccination, compounded by the lack of clarity about who (home *vs* host countries) should provide immunisation services for migrants [2].

In 2020, approximately 3.5% of the global population were classified as international migrants, of whom over 60% were labour migrants [6], while close to 1% of the world's population were rendered involuntary migrants, forcibly displaced by humanitarian crises including armed conflict, insecurity and persecution [10]. By 2020, an estimated 50% of these involuntary migrants were children and adolescents aged 18 years and below, some of whom were unaccompanied and separated children (UASC) who are deemed a high-risk group vulnerable to harm in the absence of caregiver protection [11, 12]. The United Nations High Commissioner for Refugees (UNHCR) reported that by the end of 2022, 108.4 million persons described as either refugees, internally displaced persons (IDPs), asylum seekers or other people in need of international protection[4] were forcibly displaced for reasons including conflict, persecution and human rights violations [13]. Of these, 76% reside in LMICs while 40% are children below the age of 18 years [13].

Involuntary migrants are likely to be disproportionately affected by VPD outbreaks, with health outcomes further complicated by limited or no access to health services and more so, during humanitarian crises [14, 15]. This level of vulnerability may be heightened among specific sub-populations of involuntary migrants like frail and ailing persons, women and children, whose health outcomes may be worse than those of other migrant populations [8]. Displacement, whether because of conflict or disease outbreaks during conflict, and consequent barriers in accessing healthcare accounted for the disproportionately high morbidity and mortality rates among women and young children during the Syrian conflict and the Ebola epidemics in Liberia, Sierra Leone and Guinea [16]. The precarious legal status of some involuntary migrants (illegal, undocumented, irregular, asylum seeking, stateless) may impede their access to routine and emergency health services, further increasing their vulnerability [16].

[3] The term 'migrant' and what classification entails is contested. This will be unpacked in more detail below.

[4] In mid-2022, UNHCR coined the term 'other people in need of international protection' to refer to forcibly displaced persons living outside of their home countries, who are not documented as refugees, persons in refugee-like situations or asylum seekers, but who may require international protection, including access to fundamental amenities (13).

The global increase in migrant populations has generated specific interest in the effects of migration on population health. In addition, the capacity of health systems to provide inclusive health services that are responsive to the needs of this growing migrant population continues to be a global public health concern [17, 18]. Furthermore, significant challenges have emerged with regards to immunisation of migrants, such as sub-optimal immunisation due to decimated health systems in the context of humanitarian crises, VPD outbreaks, inadequate vaccine coverage data and the impact of the influx of migrants on broader health systems of host countries [6]. A recent report on access to immunisation services among refugee and migrant populations underscored the necessity of including these growing populations in global and national immunisation programmes (NIPs) in dealing with variances in integration of migrants and refugees in NIPs [19]. The report detailed a range of context-specific barriers to immunisation among migrants including individual-, financial and non-financial-, knowledge/information-related-, socio-cultural-, legal-, administrative- and technical barriers [19]. Examining immunisation service provision among migrant populations may be useful for assessing the quality of health services tailored to the needs of this population and as a basis for engaging with policy considerations for inclusion of migrants in NIPs.

The scoping review reported below explores the provision of routine childhood and adolescent immunisation service among migrant populations in HICs and LMICs. The term children is sometimes used in literature on migrant populations as an umbrella term denoting those aged below 18 years of age (13). In this study, the United Nations' distinction between children (0-9 years old) and adolescents (10-18 years old), who are protected by the Convention on the Rights of the Child [20], will be used in unpacking published information on immunisation services and vaccination coverage among migrant populations.

Literature review

A scoping review was undertaken to: (i) identify the diverse terminology utilised with reference to migrant populations and to operationalise these terms; (ii) explore global trends in vaccination coverage among child and adolescent migrant populations and implications for control of VPDs; (iii) identify key global immunisation policies and to describe how these policies relate to childhood and adolescent immunisation services and vaccine coverage among migrant populations, and finally; (iv) understand the context of and the challenges associated with the provision of childhood and adolescent immunisation services among migrant populations. Peer-reviewed and grey literature (journal articles, books, institutional reports, theses, and policy materials) were scoped through database and reference list searches. Eligible literature sources included those published in English between 2012 to 2023, and included empirical, analytical and review papers. Further details on the review process are described in the methods section.

The literature sources reviewed featured both voluntary and involuntary migrants, mostly from the perspectives of host countries in Europe, North America, and Asia. The types of vaccines featured in the literature were consistent with the World Health Organisation (WHO) recommendations for routine childhood and adolescent vaccination, adaptable to country-specific needs and guidelines [21]. The nine routine childhood vaccines are Bacille Calmette-Guérin, hepatitis B, inactivated poliovirus vaccine, diphtheria-tetanus-pertussis containing vaccine, haemophilus influenzae type b, pneumococcal conjugate, rotavirus, measles, and rubella [21]. Vaccines recommended for adolescents are hepatitis B, for those who missed their scheduled doses during childhood and for those adolescents considered at high risk for infection. In addition, diphtheria-tetanus-pertussis containing vaccine boosters are recommended for those aged between 9 and 15 years of age, rubella for adolescent girls who had not received this vaccination previously, and Human papillomavirus (HPV) vaccine for girls from 9 to 14 years old [21]. This review identified four main clusters of literature: (i)

literature featuring various sub-populations of migrants; (ii) literature exploring immunisation service provision and vaccination coverage among migrant children and adolescents; (iii) literature focusing on immunisation policies and implications for accessible and inclusive immunisation services; and (iv) literature detailing pragmatic considerations relating to vaccination service delivery for migrants. Each of the four literature clusters is discussed in detail in the subsequent sub-sections.

How migrant populations are classified – and why this matters

Varied terminologies have been utilised with reference to migrant populations, with points of overlap between some terms. Table 1 provides a summary of terms commonly used in the literature to define migrant populations. In this review, the term migrants is utilised as an umbrella term with reference to all the sub-categories of migrants as defined in Table 1. Instances where the experiences of a particular sub-group differ from those of the rest of the migrant population are described and specific sub-groups identified. Variances among sub-populations of migrants may be consequential. The International Organisation for Migration (IOM) acknowledges that though involuntary migrants comprise a relatively small percentage of international migrants globally, often, their needs are greater than those of voluntary migrants [22]. For instance, involuntary migrants may have limited-to-no access to immunisation services during humanitarian crises [10, 23, 24] in contrast to economic migrants who can move freely between their home and host countries with the choice of receiving vaccination in either country [25, 26]. Undocumented migrants are often denied access to health services in host countries, which negatively impacts access to immunisation services, as noted in studies exploring immunisation among migrants in various countries within the European Union (EU) [27-29]. In Sweden, the illegal status of undocumented migrants, who are predominantly asylum seekers whose applications have been rejected, often deters them from accessing health services in fear of being discovered and deported, yet they often live in conditions that render them susceptible to VPDs [29]. These findings corroborate findings of two systematic reviews on factors influencing under-immunisation among migrants and implications for COVID-19 vaccination, which reported that the immigration status of undocumented migrants and fear of being exposed were deterrents in accessing vaccination services [30, 31]. Thus, one may argue that strategies to improve immunisation services should take into consideration the needs of different migrant sub-populations such as voluntary versus involuntary migrants [32].

Table 1. Summary table of terms used to define migrant populations as most commonly featured in literature

Term	Definition
[Im]migrant	a person who has shifted from their usual place of residence irrespective of their legal status, reasons for moving, if the move is transient or permanent [26, 33-36].
Asylum seeker	a person seeking protection in a country outside of their home country but whose status is yet to be determined by the host country [19, 37].
Refugee	a person who is forced to leave their home country to seek international protection due to armed conflict, persecution and/or other humanitarian crises [11, 12, 38].
Unaccompanied and separated child	a person aged 18 years and below who has been separated from both parents and other legal guardians [11].
Voluntary migrant	a person who chooses to relocate from their usual place of residence to a different location either within or outside of their country borders e.g. economic migrants [26, 27] and international students [39] .
Involuntary migrant	a person forcibly displaced within or outside of their country's border due to war, persecution and/or other humanitarian crises e.g. refugees, asylum seekers, internally displaced persons, unaccompanied and separated children, and other people in need of international protection [11-13, 38, 40].
Internal migrant	a person who voluntarily or involuntarily moved from their usual residences to other locations within their country borders, including IDPs [23, 41] and economic migrants [42].

Global trends in vaccination coverage among migrant populations and implications for control of VPDs

The literature reviewed showed that generally, migrants had lower vaccination coverage and higher risk of VPDs compared to the general population. For instance, lower vaccination coverage rates were reported among migrant children (under 7 years old) living at the Thailand-Myanmar border [43], New Zealand-based refugee and migrant children [44], and children (aged below five years) of Danish and German refugees [27, 45, 46], when compared to children in the respective general populations. A study conducted among asylum seekers in Wales observed that asylum seeking children and adolescents (5-16 years old) were three times less likely to be vaccinated against key VPDs compared to children in the general population [37]. Previous systematic reviews predominantly focused on childhood vaccination compared to that of adolescents [47-50]. One systematic review on infectious disease control in conflict settings noted that routine early childhood vaccination (0-5 years) is foremost in the migrant health agenda, though some provision is made for catch-up vaccination for older children [48]. Another review on vaccination service delivery during humanitarian crises observed that none of the studies in their review featured adolescent vaccination [49]. Other studies reporting on childhood vaccination also included adolescents or presented stratified data on vaccination coverage in which case the study participants included children, adolescent, and adult migrant populations (Appendix H).

Where vaccination among adolescent migrants was explored, lower HPV vaccination coverage rates were reported among migrants, attributed the level of knowledge and attitudes of parents towards HPV [50]. Several studies reviewed reported on vaccination coverage specifically among adolescent migrants and, specifically, HPV vaccination (Appendix I). Vaccination coverage among adolescent migrant populations globally was at times lower than that among general adolescent populations in host countries. For instance, the rate of HPV vaccination among certain sub-populations of adolescent migrants in the United States was lower than that of the general adolescent population, as illustrated in two studies on HPV vaccination-related knowledge, beliefs and practices among Arab American and Latin American mothers [51, 52]. The two studies identified several barriers to HPV vaccination including migrant's legal status, lack of medical insurance, language barriers, indigence, and deficient knowledge about HPV vaccination. In some instances, even when awareness about HPV vaccination was high, uptake remained low. A cross-sectional survey conducted among Dominican migrants living in Puerto Rico reported an HPV vaccine coverage rate of 31.7% despite 91.7% of parents being aware of HPV and HPV vaccination [33]. An intervention study conducted among a population of migrant mothers of East African descent observed discrepancies between intent to facilitate HPV vaccination for their children following the intervention (90%), and actual behaviour where six months post-intervention, only two mothers reported that their children had received HPV vaccination [53]. Relatively low HPV vaccination among migrant adolescents and variances between behavioural intent versus actual behaviour warrant further research to understand the factors that may impede HPV vaccination among these populations.

In this review, literature on vaccination coverage revolved around a shared public health concern that the influx of un- and under-vaccinated migrants compromised herd immunity, increasing the risk of VPD outbreaks. Studies conducted in Canada [54] and Scotland [25] observed that national childhood vaccine coverage rates fell below the critical threshold for achieving herd immunity in the general population. Given limited data on the immunisation status of migrants living in these countries, there has been concern for the risk of VPD outbreaks amidst suboptimal national vaccine coverage rates. Routine childhood vaccination is

widely recognised as a priority and effective public health intervention to prevent transmission of VPDs. Further, evidence from literature demonstrates that circumstances such as humanitarian crises often disrupt health systems resulting in increased vulnerability to VPDs (i) among displaced persons in the aftermath of destruction of health facilities and disruption of immunisation services, and (ii) among populations within host countries due to potential importation [24, 48]. Against this background, NIPs aim to offer direct protection to individuals against VPDs through provision of vaccination and indirect community protection via herd immunity [38]. The growing number of migrants globally warrants their inclusion in NIPs to achieve the immunisation thresholds required for populations' protection from VPDs [2, 19]. Such NIPs are based on national immunisation policies which draw from global and regional policies, as detailed in the next section.

Immunisation policies and implications for accessible and inclusive immunisation services

Global immunisation policies featured prominently in descriptions of regional and national immunisation policies and specifically, in the context of migrant inclusive policies. A study on inequality in vaccination coverage among children who sought asylum in Wales referred to The European Vaccine Action Plan (2020), underscoring the significance of reducing inequities and performance monitoring among underserved populations such as migrants [37]. A United Kingdom (UK)-based report focused on refugees as a sub-population of international migrants against the backdrop of the WHO Immunisation Agenda 2030 mandate to provide equitable access to routine vaccines via catch-up vaccinations for all age groups (life course approach), with special emphasis on vulnerable populations [6]. Implementation of policies on immunisation of incoming refugees in the UK is facilitated in partnership with IOM, a global humanitarian organisation that conducts health assessments prior to resettlement of refugees in different countries worldwide, including the UK and the USA [6, 55, 56]. In USA, IOM administers vaccines and provides vaccination documentation as part of the Vaccination Programme for USA-bound Refugees (VPR), launched in 2012 [55]. The VPR is a collaborative venture between the United States Centres for Disease Control and IOM. The initial rollout of VPR (2012-2015) was conducted in six countries - Ethiopia, Kenya, Malaysia, Nepal, Thailand, and Uganda - before extension of services to 21 countries from 2017 [55, 56].

A report on the response to a measles outbreak among Somali refugees in Kenya and Ethiopia noted that the UNHCR immunisation policy for refugee camps with 25,000 or more refugees who have resided there for five years or more (protracted refugees) is to follow NIP guidelines of host countries [57]. The NIP guidelines are shaped by WHO recommendations, namely provision of two doses of measles vaccines to all children aged between six months and 14 years via routine immunisation and sporadic supplementary immunisation activities [57]. A study highlighting the economic value of hepatitis B vaccination for refugee children at birth referred to the WHO policy of hepatitis B vaccination for all newborn babies within 24 hours of birth and adherence to completion of routine childhood hepatitis B vaccination schedules, as part of their strategy to prevent 85-95% of hepatitis B virus infections, which are highly transmissible from mother to child during birth [58]. The WHO Framework for Decision-Making on Vaccination in Humanitarian Emergencies (2017) featured in a review of the use of the pneumococcal conjugate vaccine in humanitarian emergencies, which identified acute respiratory infections and diarrhoeal diseases as the two leading causes of mortality during humanitarian crises, contributing to 20-35% child mortality rates in children aged below five years [10]

Several countries report having NIPs which are guided by migrant inclusive policies (Figure 2). Variations in immunisation policies are evident across regions, between NIPs of countries within a single region and sometimes, in implementation of national immunisation policies in different sub-regions within a country. Immunisation policies have been adapted to suit the needs of various target populations. In Asia, economic

migrants are a major target group with NIPs in this region offering comprehensive free routine childhood vaccination. In China immunisation services are offered free of charge for all children aged below 7 years, including migrant children [47, 59]. This is also the case for migrants living at the Thailand-Myanmar border via school-based immunisation programmes for migrant children [43]. Despite freely available routine childhood vaccination services, immunisation rates among migrant school children at the Thailand-Myanmar border have been reported to be consistently lower than those of non-migrant school children in both Thailand and Myanmar [43].

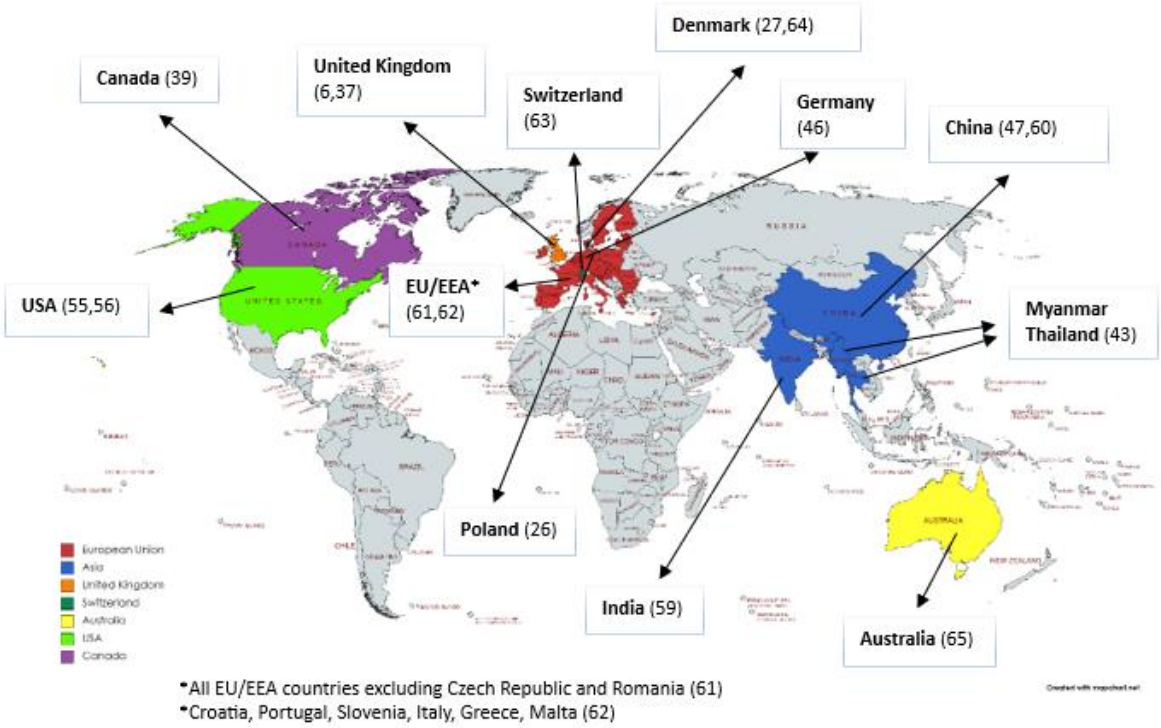


Fig 2. Countries with migrant-inclusive NIPs based on data from published literature sources included in this review (Source, Author)

A report on national immunisation policies and practices for migrants in the European Union/European Economic Area (EU/EEA) observed that 28 out of 30 EU countries have migrant inclusive immunisation polices, except for Romania, whose NIP did not include a policy for migrants at the time of the study and Czech Republic who did not participate in that study [60]. Variations in policy implementation are documented in a comparative analysis of NIPs of six European countries namely Italy, Croatia, Greece, Slovenia, Malta, and Portugal [61]. Italy, Malta, Portugal, and Greece include asylum seekers, refugees, unaccompanied minors, and irregular migrants in their NIPs while Slovenia and Croatia include only asylum seekers. Croatia, Portugal, and Slovenia provide vaccination to children and adolescents aged 0-18 years in contrast to Malta (0-16 years), and Italy and Greece (0-15 years). Germany, Switzerland, and Denmark vaccinate all migrant children [27, 46, 62]. In Denmark, the distinction is made between refugees who are treated as citizens, asylum seekers who are vaccinated through a designated health care system in asylum centres, and undocumented migrants who are excluded from vaccination services altogether [27, 63].

Australia's NIP, introduced in 1997 with comprehensive vaccination for children, prioritises equitable access irrespective of geographical or financial limitations with a focus on high-risk populations and an additional catch-up schedule [64]. However, delivery of immunisation services varies across states and territories.

Despite an extensive NIP, gaps are evident in vaccination coverage for adolescents and there is a lack of specific guidance regarding immunisation for refugees living in Australia [65]. Persons categorised as 'refugee-like' are not considered high-risk and are excluded from national immunisation projections [64]. However, the health assessment programme for incoming refugees provides verification of vaccination status and catch-up vaccination, as necessary, within six months of arrival in Australia [65]. Similarly, the UK and the USA facilitate vaccination for incoming refugees through refugee resettlement programmes in liaison with the IOM [6, 55]. All refugee children in the United States receive free vaccination cover via a federal programme known as Vaccines for Children [56].

The Immunisation Agenda 2030 supports the notion of versatile immunisation programmes which can be adapted at national level to suit local needs [2]. On one hand, this is advantageous to the extent that NIPs can develop and implement targeted immunisation interventions to suit prevailing needs and amend this as the need arises. On the other hand, the preceding paragraphs are evidence of the possibility of inadvertently excluding migrants through local interpretations of policies, which may include determining which sub-populations of migrants are considered "at-risk" and included in immunisation programmes. This is consistent with the earlier discourse on the classification of migrants and the need for clarity to ensure that the immunisation needs of all sub-populations are appropriately catered for.

Pragmatic considerations for delivering immunisation services to migrant populations

Literature on how immunisation services are delivered to migrant populations featured supply- and demand-side factors that either enhanced or impeded access to and/or utilisation of routine childhood and adolescent vaccination services. Demand-related factors included primary caregiver influence, knowledge, health provider endorsement, communication barriers, and vaccine hesitancy[5]. Several studies underscored the crucial role played by primary caregivers as key stakeholders in determining whether their children were vaccinated. This was a pertinent sub-theme on generating further buy-in for HPV vaccination among adolescent migrants where cultural norms determined who took responsibility for vaccine decision-making within families, coupled with limited knowledge about this relatively new vaccine [35, 66]. Primary caregiver influence and limited knowledge were associated with low vaccine uptake among specific migrant populations such as US-based Somali migrants [35, 66] and Bhutanese refugees in Nepal [67]. Several primary caregivers indicated willingness to vaccinate their adolescents if this was suggested by a doctor as evident among US-based Haitian, Cambodian and Vietnamese migrant mothers [68-70], and among refugees and migrants in Italy [71]. Culturally and linguistically appropriate communication enhanced vaccination uptake among migrants, many of whom preferred information on vaccines to be conveyed in their native languages [25, 72]. Conversely, vaccine hesitancy was attributed to lack of knowledge among migrants [38] and uncertainty regarding differences in vaccines offered through immunisation programmes in their home versus host countries, which fuelled mistrust in instances where vaccines were unfamiliar, as reported in a study conducted among Polish migrants residing in Scotland [25].

Supply-side considerations for vaccine service delivery included cost implications, innovative interventions, and impact of humanitarian crises. In some cases, compulsory vaccines were offered free but voluntary vaccines were available at personal cost to migrant populations[6], as in the case of Ukrainian migrants in Poland

[5] Vaccine hesitancy, as defined by The SAGE Working Group on Vaccine Hesitancy, refers to "delay in acceptance or refusal of vaccination despite availability of vaccination services."

[6] In Poland, the NIP provides mandatory childhood vaccines freely available to all, including migrant children. Non-mandatory vaccinations such as HPV vaccination, are available at personal cost from private medical practitioners.

[73]. In such instances, cost was a deterrent to migrants' accessing voluntary vaccines. In some studies, innovative interventions were utilised to improve the delivery of vaccination services to these populations. These included the use of cost-effective digital health information systems to facilitate efficient documentation of childhood vaccination by caregivers of refugee children (20), integrating childhood vaccination services with nutritional services at the local health facility level to increase access [74], introduction of immunisation packages to cater for migrants [59], and catch-up vaccination for refugees and asylum seekers [64]. Another supply-side factor was the impact of humanitarian crises on the provision of routine immunisation services and attendant outcomes, considering the reality of the persisting rather than sporadic nature of humanitarian crises such as armed conflict [24, 48]. For instance, Meningitis outbreaks have been frequently recorded among refugee populations from conflict-affected countries such as Thailand, Sudan, Rwanda, Turkey, and Afghanistan [12]. The situation is further compounded by the fact that though the meningococcal vaccine may be available in host countries, it may not be routinely included in NIPs [12]. As such, vaccination is likely to require out-of-pocket payment for out-of-routine vaccines which further impedes access. A 2019 study on immunisation coverage among refugee children in Berlin reported a stark difference in full vaccination coverage between Syrian refugee children aged below five years (28%) and those aged above five years (74%), attributed to the 2011 civil war in Syria [46].

The preceding discussion illustrates the complexity of health systems factors that determine immunisation access and uptake among migrant populations. In some instances, service delivery is impeded by factors such as humanitarian crises and costs in cases where immunisation services are offered at a fee. In other instances, immunisation services may be available but other factors, such as socio-cultural beliefs and the legal status of migrants may serve as deterrents in utilising available services. Further research to establish how supply- and demand-side factors interact and influence access to and uptake of immunisation services among different sub-populations of migrants may be useful in tailoring interventions appropriately.

Health systems considerations for delivery and uptake of vaccines among migrant populations

Various frameworks have been utilised to examine the interactions between activities, processes and outcomes related to immunisation services for migrant populations. In the context of global policies encapsulated in the Immunisation Agenda 2030, four key premises should be considered in applying these frameworks. First, the global mandate of universal immunisation coverage which prioritises underserved populations such as marginalised persons, migrants, and persons in precarious situations such as war [2, 19]. Second, the equity mandate of immunisation for all, regardless of status, versus evidence of inequity in availability and access to immunisation by migrant populations coupled with insufficient uptake of services [2, 19, 60]. Third, recognition that the factors influencing immunisation among migrant populations are intricate and context-specific [30, 31]. Fourth, health system strengthening is critical in achieving the universal and equity mandates and particularly in the context of developing "sustainable immunisation programmes embedded within primary health care as the basis for achieving high vaccination coverage and universal health coverage" [2]. In subsequent paragraphs, four frameworks, that speak to each of the four premises, are briefly described: the P3 Model [75], the 5As Framework [76], the WHO health system building blocks [77], and the Health Systems Strengthening Framework by Witter et al. [78].

The P3 Model, developed by scholars researching vaccine acceptance and uptake, foregrounds the health service delivery context by examining how interactions between patients (patient level influences) and providers (provider level influences), within clinical settings (practice level influences), shape preventive health practices [75]. Proponents of this model argue that these three levels are essential components of preventive

care services such as immunisation, noting that many of the widely used health models often consider one or, at best, two of the three components [75]. One of the studies reviewed employed the P3 Model to explore maternal decision-making on HPV vaccination for adolescents among a population of Vietnamese migrants in the USA [68]. Categorising the factors influencing the decision-making processes for Vietnamese mothers into the three levels yielded a more holistic picture of the context and identified gaps in health service delivery. The P3 Model highlights interactions between two key health system actors (providers and patients) and, by extension, other actors such as family members and suppliers of health-related goods and services (including immunisation services), rendering it a useful model for examining the roles of various health system stakeholders in vaccination service provision.

The 5As Framework posits that vaccine uptake is determined by complex, multiple factors, which include structural, socio-behavioural, and demographic factors [76]. These factors, termed the 5As, are access, affordability, awareness, acceptance, and activation. A systematic review examining determinants of under-immunisation and low vaccine uptake among migrants in Europe utilised the 5As framework to present their findings and make recommendations for enhancing COVID-19 immunisation for migrants in the region [30]. The review reported that access barriers were mainly associated with HPV, measles, and influenza vaccines and specifically among migrant populations from Eastern Europe and Muslim migrants. The study further identified 23 key factors associated with under-vaccination among migrant populations, noting a prevalence of under-vaccination among migrant populations (i) from Africa (ii) that were either refugees or asylum seekers (iii) that resettled recently in host countries [30].

Four of the 5As correspond with barriers to and facilitators of vaccines among refugees and migrants (Table 2), reported in the WHO Global Evidence Review on Health and Migration (GEHM) series report [19]. The GEHM series, a publication of the WHO Health and Migration Programme, compiles migration-related data intended to inform policy makers on significant migration-related public health issues [19]. The cited report was their third series report of 2022.

Table 2. Barriers to vaccine delivery and uptake across the 5As framework domains (Source, Author)

5As framework domains	**Description**	**Barriers to/facilitators of vaccines among refugee and migrant populations**
Access	Ability to reach services (e.g., physical distance to services, migrant inclusive policies)	▪ Legal, administrative, and technical ▪ Policy-related ▪ Availability-related ▪ Relating to accessibility on an individual level
Affordability	Monetary and non-monetary costs (e.g., loss of work hours) associated with vaccination	▪ Relating to financial and non-financial affordability/cost and convenience
Awareness	Good knowledge and access to information about vaccines	▪ Relating to knowledge, [mis]information, and awareness
Acceptance	Continuum of responses including agreement, refusal, hesitancy, and complacency	▪ Relating to personal, social, cultural, and religious beliefs and norms and acceptability of vaccines ▪ [mis]trust
Activation	Factors that prompt individuals to get vaccinated	▪ Health provider recommendation ▪ Family & peer influence

The WHO proposes an analytical framework which describes health systems in terms of six building blocks, namely, leadership and governance, health service delivery, health workforce, health financing, health

information systems, and medical products, vaccines and technologies [77]. The health systems building blocks provide a helpful lens with which to examine the immunisation-related needs of migrant populations and health systems factors that enhance or deter delivery and uptake of such services in these populations and also resonate with the 5As (Table 4). In evaluating the nature of interventions that characterise robust health systems, the Witter et al. Health Systems Strengthening Framework [78] presents a shift in focus from the vertical effects of individual health system building blocks to effects that transcend multiple building blocks, the processes involved in such cross-cutting interactions, and the resultant outcomes, which serve as indicators of robust health systems. These outcomes resonate with the findings and subsequent policy considerations issued by the WHO GEHM series (19), whose emphasis is ensuring inclusion of migrants in immunisation policy and practice.

Ultimately, the P3, 5As, WHO and Witter et al. frameworks are complementary in the sense that each provides a different yet related perspective on factors that influence immunisation service delivery and uptake. The P3 Model foregrounds health system actors, the 5As framework emphasises pragmatic determinants, while the WHO framework centres on the health systems factors that either facilitate or hinder immunisation service delivery among migrant populations. The Witter et al. framework emphasises a theory of change approach with a focus on change processes across building blocks and key outcomes representative of effective health systems. Integrating these frameworks in studies seeking to assess the determinants of vaccine delivery and uptake may enhance understanding of health systems-related complexities, which may in turn inform policy and ultimately, improve practice. Drawing from these four frameworks, an analytical framework is proposed (Table 3). This proposed framework consolidates health system inputs (building blocks), determinants (facilitators and barriers), actors (patients and providers) and anticipated outcome indicators of strong health systems that support migrant inclusiveness. The proposed framework has been specifically adapted for involuntary migrants, who will be the focus of phase two of this systematic review study (see methods section).

Table 3. Analytical framework - health system determinants of vaccination delivery and uptake among involuntary migrants

Context ▪ Forced displacement/ involuntary migration e.g. due to war, persecution, humanitarian crises ▪ Global goals/policies: Immunisation Agenda 2030; WHO 2022 Global Evidence Review on Health and Migration; Universal health coverage			
5As framework domains	**WHO health system building blocks**	**Indicators of robust health systems**	**P3 model – health system influences**
▪ access	▪ service delivery	▪ equity	▪ provider level
▪ awareness	▪ medicines/vaccines	▪ quality	▪ patient level
▪ acceptability	▪ information systems	▪ resource mobilisation	▪ practice level
▪ acceptance	▪ finance	▪ high immunisation coverage	
▪ activation	▪ health workforce	▪ social/financial risk protection	
	▪ leadership/governance	▪ responsiveness	

Study rationale

Findings from the scoping review highlight several pertinent issues regarding the public health benefits of migrant-inclusive NIPs. First, achieving global targets for the control and elimination of VPDs necessitates inclusion of migrants in NIPs, given that they form a sizeable population that is continually growing spurred by climate change, conflict and humanitarian crises, and disease outbreaks and pandemics. This underscores the urgency to better understand the immunisation needs of migrants so that such evidence may inform adaptation of regional and national immunisation policies for greater inclusivity and health equity. Second, inclusion of migrants in NIPs will be beneficial to the health of this vulnerable population while simultaneously

benefitting the health of host countries by reducing the risk of importation of VPDs. Third, classifying migrants as a homogeneous group may result in overlooking unique experiences of different migrant sub-populations and ultimately not meeting their expressed needs. As such, there is value in conducting research on specific sub-populations of migrants to inform policy and practice via targeted interventions. Fourth, as demonstrated by the extensive evidence base on vaccination among children compared to that of adolescent migrant populations, higher priority is given to routine vaccination for migrant infants and younger children compared to adolescents who are relatively underserved. Yet, recent studies indicate a growing concern for the significant number of unaccompanied minors. The HPV vaccine is a more recent addition to global routine immunisation schedules for adolescents, thus may serve as a good proxy for understanding immunisation programmes for this under-prioritised population of migrants. Fifth, while HPV is not associated with VPD outbreaks, high prevalence of cervical cancer could burden health systems. For instance, high costs associated with curative cervical cancer management in LMIC contexts where young women develop cancer during their most productive work years negatively impacts national economies [79]. The WHO 90-70-90 strategy to eliminate cervical cancer as a global public health threat by 2030 prioritises HPV vaccination of 9-14-year-olds as the primary strategy for cervical cancer prevention and control [80]. Finally, the use of conceptual frameworks tailored to the migrant context and lived experience could aid in capturing the complexity and magnitude of factors which facilitate or impede vaccine delivery and uptake. This level of enquiry may produce useful evidence required by key stakeholders (National Technical Advisory Groups, immunisation managers, donor agencies and researchers) involved in establishing equitable immunisation programmes.

Research question

What are the health system determinants of delivery and uptake of HPV vaccination services among involuntary migrant populations?

Methods

A systematic review study will be utilised to address the research question. This study will comprise two phases: Phase 1 is the scoping review, which is reported in the preceding section, and phase 2 will be a qualitative systematic review.

Phase 1: Scoping review

A scoping review was used for the exploratory purpose of mapping evidence of access to routine childhood and adolescent immunisation services and vaccine coverage among migrant populations[7]. Such reviews are commonly used to: investigate the breadth and range of literature available in an area of interest in the sense of scoping extant literature, including illuminating key concepts; to search, summarise and synthesise existing literature related the topic of interest; identify lacunae in existing research as possible entry points for further research; as a preamble to a systematic review, in which case the literature review provides an evidence base for determining the specific focus of the systematic review [81-84]. The literature review provided a starting point to explore the breadth and range of literature pertaining to access to routine immunisation services and vaccine coverage among child and adolescent migrant populations, including unpacking and operationalising the term 'migrant populations', with a view to identifying the specific population of focus and determining the geographical and temporal parameters for the study. The process of scoping the literature revealed gaps in existing research which was helpful in framing and justifying the substantive relevance of the systematic

[7] It is the standard format of this mini dissertation to report on the scoping review phase in the past tense (as it has been completed ahead of this protocol), and for the findings of this to be reported in the literature review of the protocol.

review question to be explored in phase 2. The literature review was guided by Levac et al., rendition of Arksey and O'Malley's framework [83] and the Joanna Briggs Institute (JBI) updated guidelines for scoping review methodology [84].

This review was conducted between February and April 2023 and included peer reviewed and grey literature sourced from: PubMed, Cochrane, Web of Science, Scopus and EBSCOHost (Academic Search Premier, Africa-Wide Information, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Health Source Nursing/Academic Edition, Health Source Consumer Edition, APA PsycArticles and APA PsycInfo). Organisational databases including WHO, UNICEF, UNHCR, Gavi, the Vaccine Alliance were also searched for relevant policy documents and reports. Supplementary searches were conducted by reviewing reference lists of articles and additional searches in Google Scholar. Search terms were iteratively developed and refined to capture the breadth of literature available on routine childhood and adolescent immunisation services and vaccine coverage among migrant populations (Table 4). Relevant literature published from 2012 to 2023 were sourced. The significance of 2012 in the immunisation literature is that this was when the Global Vaccine Action Plan was ratified by all 194 WHO member states [1]. Even so, provision was made for earlier literature that was particularly relevant. Descriptive findings were analysed and reported in narrative summaries.

Table 4: Scoping review search terms (Source, Author)

Population	Migrants OR asylum seekers OR displaced OR refugees OR transients OR undocumented OR forcibly displaced OR resettled OR marginalised OR 'hard-to-reach' OR 'persons-of-interest' OR 'persons-of-concern' OR internally displaced persons OR irregular OR illegal OR aliens OR foreign-born OR 0-18 years OR children OR childhood OR adolescent OR teenager
Intervention	Routine immunisation OR routine immunization OR Vaccination OR Vaccine OR immunization programmes OR immunisation programmes
Comparison	N/A
Outcomes	Coverage OR uptake OR quality OR acceptability OR service provision OR service delivery OR healthcare cost OR cost effectiveness OR healthcare provision

Phase 2: Qualitative systematic review

The second phase of this study will comprise a qualitative systematic review. Qualitative systematic reviews seek to enhance understanding by synthesising qualitative evidence from empirical research studies and consolidating this evidence, in the sense of building cumulative knowledge rather than merely summarising evidence from individual studies [85, 86]. Qualitative systematic reviews are well suited to studies which seek to understand phenomena of interest from various perspectives, within their specific contexts, culminating in robust descriptions of phenomena studied [85, 87]. This methodological approach has been used in a wide range of public health research including immunisation studies on maternal and child health issues [49, 88], HPV vaccination-specific qualitative systematic reviews [89, 90], and reviews on immunisation among migrant populations [49, 50, 91]. The terms qualitative evidence synthesis and qualitative research synthesis are alternative terms used to describe qualitative systematic reviews [85]. Qualitative systematic reviews can be conducted as part of a multi-section review of elaborate interventions or as a stand-alone review [86], as is the case with this review study.

Searching for literature will entail refining of search terms included in Phase 1 of this study to facilitate a more nuanced focus on involuntary migrants (forcibly displaced persons including refugees, persons in refugee-like situations, asylum seekers, IDPs, UASC, and other persons in need of international protection) and HPV vaccination as a proxy for routine adolescent immunisation. Alternative terms will be generated from

literature reviewed in Phase 1, online searches for synonyms and the use of medical subject headings (MeSH) where appropriate, for a more comprehensive search. Literature will be obtained from electronic databases such as PubMed, Cochrane, Web of Science, Scopus and EBSCOHost (Academic Search Premier, Africa-Wide Information, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Health Source Nursing/Academic Edition, Health Source Consumer Edition, APA PsycArticles and APA PsycInfo). Further, Google Scholar will be utilised in an additional complementary search.

Inclusion criteria

1. Peer reviewed qualitative evidence from primary qualitative, quantitative and mixed-methods studies.
2. Studies reporting on HPV vaccination among involuntary migrants, that is migrants who are forcibly displaced, including studies in which involuntary migrants are one of several sub-populations of migrants studied.
3. Studies written in English.

Exclusion criteria

1. Reviews, grey literature including conference proceedings, commentaries, and editorials, and publications that do not present primary qualitative evidence.
2. Studies that do not include involuntary migrants either as the main population or as a sub-population of migrants.
3. Studies that do not feature HPV vaccination.

Literature screening and selection

Literature from the selected databases will be exported to EndNote [92], where initial duplicates will be removed, and then imported into the Rayyan online management platform [93] for further screening and selection of articles for the review. Titles and abstracts will be screened for eligibility and those beyond the scope of the study excluded, culminating in a list of articles eligible for full text review. Any full texts not meeting the eligibility criteria for this review will be excluded.

Quality assessment

The JBI critical appraisal tools [94-96], and the Mixed Methods Appraisal tool [97] will be used to appraise the overall quality of full text articles selected for this review (Appendices J-M). The JBI appraisal tools have been widely utilised in qualitative evidence syntheses [98], while the Mixed Methods Appraisal tool is specifically tailored for mixed methods studies in systematic reviews [97]. Appraisal will entail confirming coherence between research questions, study objectives and methods employed, including ethics and rigour considerations. A quality assessment will be conducted by the primary reviewer (MPH student) and documented using the relevant checklist. Upon completion of the initial quality assessment by the primary reviewer, a summary of the assessment will be shared with two academic supervisors each of whom will provide feedback on the appraisal assessment. Decisions on eligible articles will be determined through an iterative process of comparing and deliberating on the assessments made by each of the reviewers.

Data extraction

Extraction of data from eligible full texts will be guided by the information stipulated on the data extraction sheet (Appendix E). The data extraction variables are drawn from the analytical framework of this study (Table 3):

- Study characteristics refer to publication-related and socio-demographic descriptive information namely author(s), journal where article is published, publication title, study design, study aim, classification of migrant population(s) for example, IDP, asylum seeker, refugee or other relevant terminology used to

describe involuntary migrants, migrants' country/region of origin and migrants' current host country/region of residence.

- Context refers to the prevailing context, namely: the political context of displacement, for instance, armed conflict, persecution, and other humanitarian crises; the policy context, for instance if a host country has an NIP and whether the NIP is migrant-inclusive or not; the socio-economic context, namely HIC or LMIC.
- Health systems determinants of HPV vaccination uptake and delivery will comprise: the WHO six building blocks, namely, leadership and governance, health service delivery, health workforce, health financing, health information systems, and medical products, vaccines, and technologies, and; facilitators of and barriers to HPV vaccination uptake and delivery pertaining to access, affordability, awareness, acceptance, and activation (5As Framework) at patient, provider and practice levels (P3 Model).
- Outcome indicators of robust health systems including equity, quality, resource mobilisation, risk protection, high coverage and responsiveness will also be identified.

Data analysis

The iterative process between data extraction, analysis and synthesis makes it difficult to clearly delineate these processes in a qualitative review [85]. For instance, the interactive process of auditing the data extraction summaries conducted by the review team might be considered a part of the initial data analysis process. These summaries will be analysed using a thematic synthesis, an approach to qualitative reviews that combines the more descriptive and deductive components of thematic analysis with an inductive, interpretive layer which generates analytical themes [86, 99]. Cochrane scholars distinguish between 'thin' and 'thick' qualitative evidence, with the former describing data with low contextual detail and the latter data which has high contextual detail [100]. Thin data is more suited to descriptive analysis, while thick qualitative evidence is more suited to interpretive analysis [85, 86]. Thematic synthesis comprises three main stages, which might be misconstrued as a linear progression from one stage to the next, but the actual process is iterative necessitating movement between the stages as part of the meaning-making process. The first stage, which is the starting point of any qualitative type of synthesis, will involve detailed engagement with the evidence and generating of initial descriptive codes that closely represent evidence from the primary studies reviewed [85, 99]. The second stage will entail further synthesis and development of descriptive themes arising from descriptive codes. In instances where primary data are 'thin', thematic synthesis could conclude after this second phase [85]. However, it is likely that some of the evidence generated will be 'thick' and thus suited to the third stage, which is development of analytical themes aimed at enhancing understanding through generation of new perspectives, including explanations and constructs related to health systems strengthening in the context of immunisation services for involuntary migrants.

Rigour

Various measures will be in place to ensure trustworthiness of the review findings and the entire review process. Credibility will be enhanced by ensuring that the primary reviewer works closely with two academic supervisors who will serve as external auditors in each step of this study and, in the process, facilitate researcher triangulation [101, 102]. Any discrepancies arising in any part of the review process will be discussed and resolved collaboratively. Reporting the systematic review search strategy with transparency and maintaining an updated data extraction sheet, and documentation of analysis processes as an audit trail throughout the review process, will ensure dependability and transferability. This will involve honesty and transparency in assessment and description of contextual and conceptual aspects of studies reviewed as either thin or thick, regarding contextual components, and rich or poor with reference to conceptual detail [100]. The idea is that though no actual scores will be given, the scoring may be useful in indicating the quality of the various studies reviewed.

Given that this review has a relatively narrow focus on HPV vaccination among involuntary migrants, extra effort will be made to furnish as much detail as possible so that enough information is provided to judge the extent to which the review findings may be transferable to contexts other than those studied. The audit trail will also include a detailed account of decisions including those relating to methods, theory, and analytical decisions throughout the review process, to increase confirmability of the findings [101, 102]. Working as a team in selection and appraisal of articles and data extraction will reduce researcher bias, while drawing from different publication types (qualitative, quantitative, and mixed methods) will reduce publication and selection bias and, by so doing, ensure confirmability of the results. Throughout the process, reflexivity will be practised by openly acknowledging issues such as potential conflicts of interest and ways in which reviewer roles or positionality might influence the review process [85, 102].

Ethics

This study is a systematic review based on secondary data retrieved from electronic databases and, as such, does not involve direct human participation and attendant risks associated with their involvement. Considering this, formal ethics approval is not a requirement. However, in keeping with the university procedures of research for academic degree purposes, the study will be vetted by a departmental research review committee to ensure that it meets the requirements for a Master of Public Health mini dissertation.

Dissemination of findings

Findings will be disseminated in the form of a narrative analysis organised in a thematic easy-to-read manner, and in line with the research objectives. The findings will be synthesized into a manuscript and submitted to a peer reviewed journal for publication. Findings will also be presented at meetings including the Vaccine for Africa's Annual African Vaccinology Course, which attracts a range of regional stakeholders including policymakers, healthcare workers and academic researchers, as well as seminars, research meetings and Research Day events hosted by the School of Public Health, at the University of Cape Town.

Study budget

This is a desk-based study so the only potential expenses would relate to internet access for literature searches, sending and uploading drafts of the systematic review for sharing with supervisors. However, free internet access, including full access to the university's online databases is available and as such, no costs will be incurred during the study.

Proposed timeline

	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24
Scoping review																					
Protocol development																					
Protocol submission (drafts)																					
Data extraction & analysis																					
Manuscript write up																					
Manuscript submission (drafts)																					
Intent to submit																					
Mini dissertation submission																					
Journal manuscript submission																					

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Appendix B: PRISMA checklist

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

Section and Topic	Item #	Checklist item	Location where item is reported
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	5-6 & Fig 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Fig 1
Study characteristics	17	Cite each included study and present its characteristics.	6-9
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	6 & Appendix F
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	10-22
	23b	Discuss any limitations of the evidence included in the review.	22
	23c	Discuss any limitations of the review processes used.	22
	23d	Discuss implications of the results for practice, policy, and future research.	21-22 & Fig 3
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Not registered
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	41-44

Section and Topic	Item #	Checklist item	Location where item is reported
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	N/A
Competing interests	26	Declare any competing interests of review authors.	None
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Search strategy available in Appendix D

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

Appendix C: Departmental Research Committee Approval Letter

School of Public Health
Departement Openbare Gesondheid
Isikolo Sempilo Yoluntu

UNIVERSITY OF CAPE TOWN

Dr Tammy Phillips (Chair)
Departmental Research Committee
University of Cape Town Faculty of Health Sciences
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T: +27 (0) 21 406 6948
E: tammy.phillips@uct.ac.za
www.publichealth.uct.ac.za

04 April 2024

STUDENT NUMBER: KTHJEN002

Dear Dr Jennifer Nyawira Githaiga,

Please be advised that this protocol has been reviewed by the School of Public Health Departmental Research Committee (DRC), agreeing that the study does not require Human Research Ethics Committee (HREC) approval.

Title: Routine childhood and adolescent immunisation among migrant populations

Please upload this to Peoplesoft in the 'Copy of Ethics Approval Letter' section when you do your Intent to Submit.

Kind regards

Dr Tammy Phillips
Chair: Departmental Research Committee
School of Public Health

Appendix D: Summary of literature searches (Source, Author)

PubMed

Search	Query	Items found
#1	(“Transients and Migrants/classification"[Mesh] OR "Transients and Migrants/legislation and jurisprudence"[Mesh])	439
#2	Migrants OR "asylum seekers" OR displaced OR refugee OR transients OR undocumented OR "forcibly displaced" OR resettled OR "persons-of-interest" OR "internally displaced persons" OR irregular OR illegal OR "illegal immigrant" OR aliens OR "foreign-born" OR "internationally displaced person" OR "unaccompanied child*" OR "unaccompanied minor" OR "separated child*" OR "involuntary migrant" OR "stateless person"	734,222
#3	(("Transients and Migrants/classification"[Mesh] OR "Transients and Migrants/legislation and jurisprudence"[Mesh])) OR (Migrants OR "asylum seekers" OR displaced OR refugee OR transients OR undocumented OR "forcibly displaced" OR resettled OR "persons-of-interest" OR "internally displaced persons" OR irregular OR illegal OR "illegal immigrant" OR aliens OR "foreign-born" OR "internationally displaced person" OR "unaccompanied child*" OR "unaccompanied minor" OR "separated child*" OR "involuntary migrant" OR "stateless person")	734,222
#4	("Papillomavirus Vaccines/administration and dosage"[Mesh] OR "Papillomavirus Vaccines/supply and distribution"[Mesh])	3,529
#5	"Human papillomavirus vaccin*" OR "HPV vaccin*" OR "human papillomavirus immuni*"	12,062
#6	(("Papillomavirus Vaccines/administration and dosage"[Mesh] OR "Papillomavirus Vaccines/supply and distribution"[Mesh])) OR ("Human papillomavirus vaccin*" OR "HPV vaccin*" OR "human papillomavirus immuni*")	12,694
#7	"health care provider" OR "health provider" OR "health policy" OR Coverage OR uptake OR quality OR availability OR acceptability OR awareness OR access OR "service provision" OR "service delivery" OR affordability OR "healthcare cost" OR "cost effectiveness" OR "healthcare provision" OR efficiency OR safety OR "financial risk protection" OR equity OR responsiveness OR "health outcomes" OR "health system" OR efficacy	10,028,264
#8	(((("Transients and Migrants/classification"[Mesh] OR "Transients and Migrants/legislation and jurisprudence"[Mesh])) OR (Migrants OR "asylum seekers" OR displaced OR refugee OR transients OR undocumented OR "forcibly displaced" OR resettled OR "persons-of-interest" OR "internally displaced persons" OR irregular OR illegal OR "illegal immigrant" OR aliens OR "foreign-born" OR "internationally displaced person" OR "unaccompanied child*" OR "unaccompanied minor" OR "separated child*" OR "involuntary migrant" OR "stateless person")) AND ((("Papillomavirus Vaccines/administration and dosage"[Mesh] OR "Papillomavirus Vaccines/supply and distribution"[Mesh])) OR ("Human papillomavirus vaccin*" OR "HPV vaccin*" OR "human papillomavirus immuni*"))) AND ("health care provider" OR "health provider" OR "health policy" OR Coverage OR uptake OR quality OR availability OR acceptability OR awareness OR access OR "service provision" OR "service delivery" OR affordability OR "healthcare cost" OR "cost effectiveness" OR "healthcare provision" OR efficiency OR safety OR "financial risk protection" OR equity OR responsiveness OR "health outcomes" OR "health system" OR efficacy)	188
	Exported all 188 references to Endnote	

EBSCOHost

Search	Query	Items found
#1	Migrants OR "asylum seekers" OR displaced OR refugee OR transients OR undocumented OR "forcibly displaced" OR resettled OR "persons-of-interest" OR "internally displaced persons" OR irregular OR illegal OR "illegal immigrant" OR aliens OR "foreign-born" OR "internationally displaced person" OR "unaccompanied child*" OR "unaccompanied minor" OR "separated child*" OR "involuntary migrant" OR "stateless person"	861,744
#2	"Human papillomavirus vaccin*" OR "HPV vaccin*" OR "human papillomavirus immuni*"	20,705
#3	"health care provider" OR "health provider" OR "health policy" OR Coverage OR uptake OR quality OR availability OR acceptability OR awareness OR access OR "service provision" OR "service delivery" OR affordability OR "healthcare cost" OR "cost effectiveness" OR "healthcare provision" OR efficiency OR safety OR "financial risk protection" OR equity OR responsiveness OR "health outcomes" OR "health system" OR efficacy	9,506,200
#4	#1 AND #2 AND #3	180
	80 duplicates were automatically removed during export to EndNote, so 100 articles were exported to EndNote	
	Searched in: Academic Search Premier, Africa-Wide Information, CINAHL, Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, APA PsycArticles, APA PsycInfo	

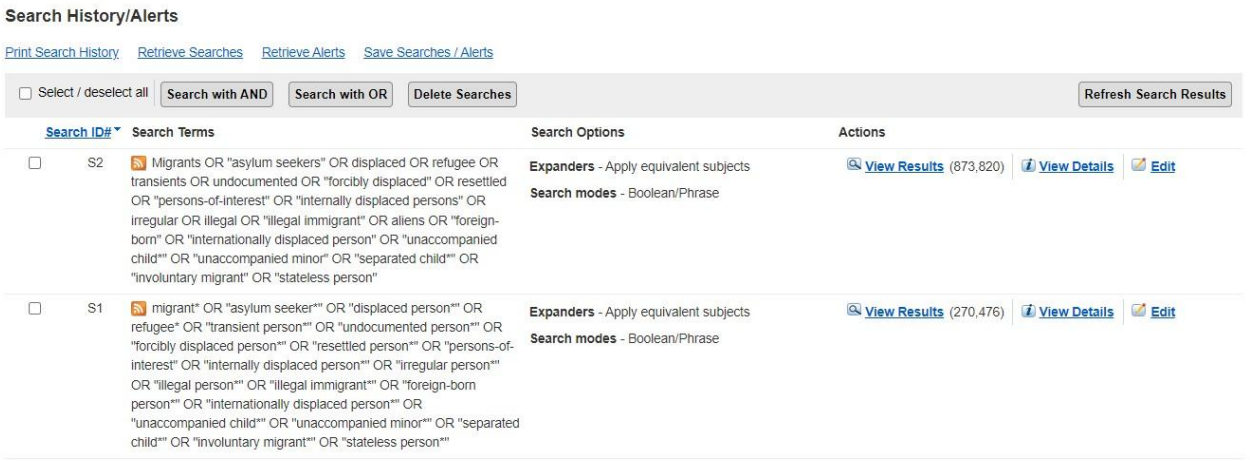
Web of Science

Search	Query	Items found
#1	Migrants OR "asylum seekers" OR displaced OR refugee OR transients OR undocumented OR "forcibly displaced" OR resettled OR "persons-of-interest" OR "internally displaced persons" OR irregular OR illegal OR "illegal immigrant" OR aliens OR "foreign-born" OR "internationally displaced person" OR "unaccompanied child*" OR "unaccompanied minor" OR "separated child*" OR "involuntary migrant" OR "stateless person"	939,933
#2	"Human papillomavirus vaccin*" OR "HPV vaccin*" OR "human papillomavirus immuni*"	13,474
#3	"health care provider" OR "health provider" OR "health policy" OR Coverage OR uptake OR quality OR availability OR acceptability OR awareness OR access OR "service provision" OR "service delivery" OR affordability OR "healthcare cost" OR "cost effectiveness" OR "healthcare provision" OR efficiency OR safety OR "financial risk protection" OR equity OR responsiveness OR "health outcomes" OR "health system" OR efficacy	10,069,547
#4	#1 AND #2 AND #3	122
	Exported all 122 references to EndNote	

Scopus

Search	Query (DATE) 24 October 2023	Items found
#1	(TITLE-ABS-KEY (migrant* OR "asylum seeker*" OR "displaced person*" OR refugee* OR "transient person*" OR "undocumented person*" OR "forcibly displaced person*" OR "resettled person*" OR "persons-of-interest" OR "internally displaced person*" OR "irregular person*" OR "illegal person*" OR "illegal immigrant*" OR "foreign-born person*" OR "internationally displaced person*" OR "unaccompanied child*" OR "unaccompanied minor*" OR "separated child*" OR "involuntary migrant*" OR "stateless person*"))	170,209
#2	(TITLE-ABS-KEY ("Human papillomavirus vaccin*" OR "HPV vaccin*" OR "human papillomavirus immuni*"))	13,604
#3	(TITLE-ABS-KEY ("health care provider*" OR "health provider*" OR "health polic*" OR "health Coverage" OR "vaccin* uptake" OR "vaccin* quality" OR "vaccin* availability" OR "vaccin* acceptability" OR "vaccin* awareness" OR "vaccin* access" OR "vaccin* service provision" OR "vaccin* service delivery" OR "vaccin* affordability" OR "vaccine healthcare cost" OR "vaccin* cost effectiveness" OR "vaccin* healthcare provision" OR "vaccin*efficiency" OR "vaccin* safety" OR "vaccin* financial risk protection" OR "vaccine* equity" OR "vaccin* responsiveness" OR "vaccin* health outcome*" OR "vaccin* health system*" OR "vaccin* efficacy"))	213,162
#4	#1 AND #2 AND #3	44
	Exported all 44 references to EndNote	

***** Searches were optimised by identifying key search words and variations of these including synonyms, truncations, Boolean operators and medical subject headings (MeSH) terms, as appropriate, per database. For instance, in Ebscohost truncations in some search strings yielded significantly less outputs so we opted not to use these:



Example of Ebsochost database truncations (S1) yielding significantly less outputs than no truncations (S2)

Appendix E: Template of the data extraction sheet (Source, Author)

									Context				WHO health system building blocks					
Author/year	Journal name	Title	Design	Aim	Classification of migrants	Country/ region(s) of origin	Country/ region of current residence	Actors	socio-cultural context	Political context of forced displacement	Policy context (NIP/migrant-inclusive or not)	Economic context (HIC, LMIC)	Leadership/ governance	service delivery	health workforce	Financing	Health information systems	Medical products, vaccines, technologies

Health systems facilitators of HPV vaccination uptake					Health systems barriers to HPV vaccination uptake				
Access-related (e.g. administrative, legal, technical, policy, availability)	**Affordability-related** (e.g. financial and non-financial affordability/cost and convenience)	**Awareness-related** (e.g. knowledge, [mis]information, and awareness)	**Acceptance-related** (e.g. personal, social, cultural, and religious beliefs and norms and acceptability of vaccines, [mis]trust)	**Activation-related** (e.g. health provider recommendation, family & peer influence)	**Access-related** (e.g. administrative, legal, technical, policy, availability)	**Affordability-related** (e.g. financial and non-financial affordability/cost and convenience)	**Awareness-related** (e.g. knowledge, [mis]information, and awareness)	**Acceptance-related** (e.g. personal, social, cultural, and religious beliefs and norms and acceptability of vaccines, [mis]trust)	**Activation-related** (e.g. health provider recommendation, family & peer influence)

Outcome indicators					
Indicators of robust health systems evident in migrant-inclusive NIPS					
Equity	Quality	Resource mobilisation/efficiency	High coverage	Social & financial risk protection	Responsiveness

Appendix F: Summaries of quality assessment appraisals of included studies

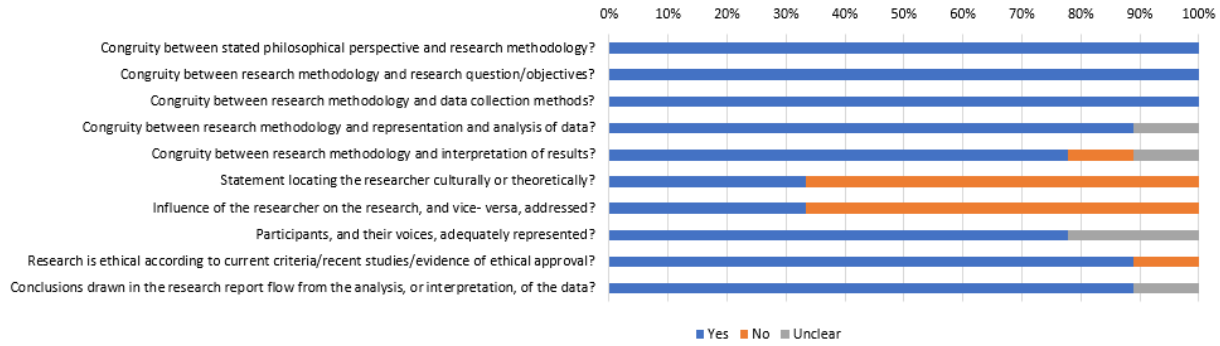


Figure A. JBI summary appraisal of qualitative studies

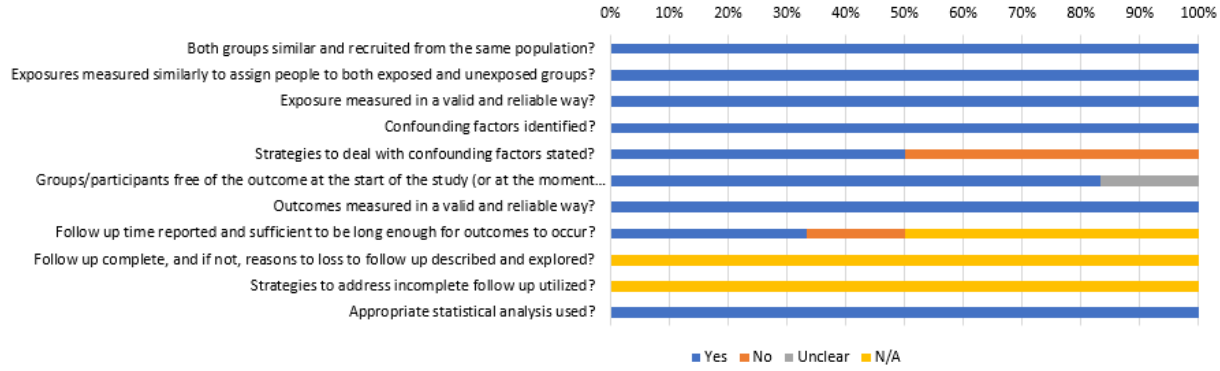


Figure B. JBI summary appraisal of cohort studies

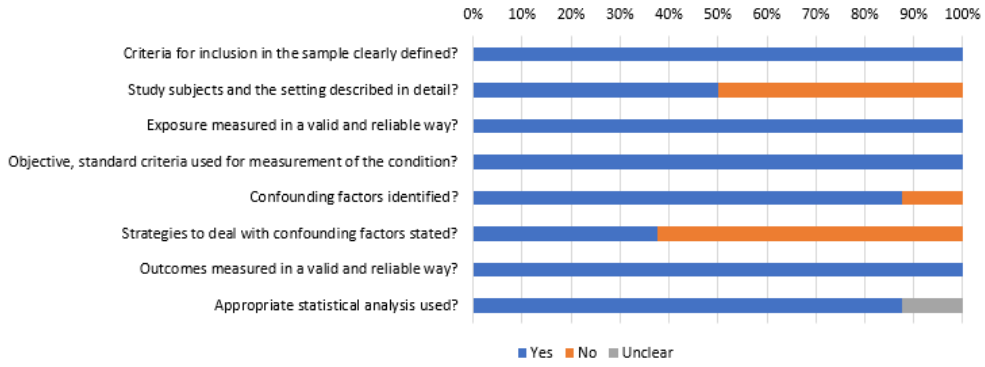


Figure C. JBI summary appraisal of cross-sectional studies

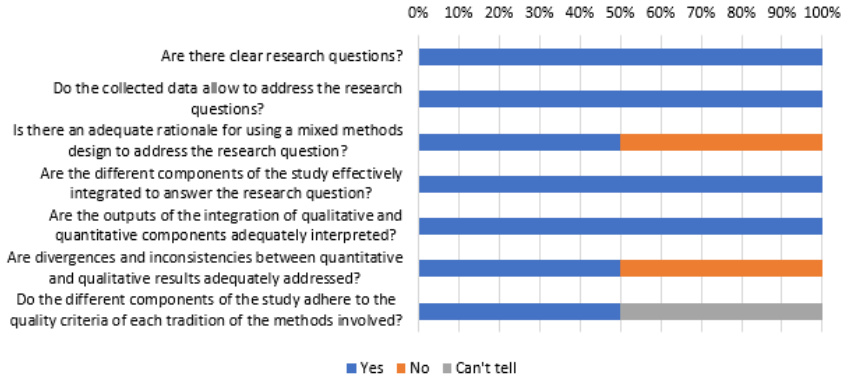


Figure D. MMAT appraisal of mixed methods studies

Appendix G: PLOS Global Public Health submission guidelines

Style and Format

File format

Manuscript files can be in the following formats: DOC, DOCX, or RTF. Microsoft Word documents should not be locked or protected. LaTeX manuscripts must be submitted as PDFs. Read the LaTeX guidelines.

Length

Manuscripts can be any length. There are no restrictions on word count, number of figures, or amount of supporting information.

We encourage you to present and discuss your findings concisely.

Font

Use a standard font size and any standard font, except for the font named "Symbol". To add symbols to the manuscript, use the Insert → Symbol function in your word processor or paste in the appropriate Unicode character.

Headings Limit manuscript sections and sub-sections to 3 heading levels. Make sure heading levels are clearly indicated in the manuscript text.

Layout and spacing

Manuscript text should be double-spaced.

Do not format text in multiple columns.

Page and line numbers

Include page numbers and line numbers in the manuscript file. Use continuous line numbers (do not restart the numbering on each page).

Footnotes

Footnotes are not permitted. If your manuscript contains footnotes, move the information into the main text or the reference list, depending on the content.

Language Manuscripts must be submitted in English.

You may submit translations of the manuscript or abstract as supporting information. Read the supporting information guidelines.

Abbreviations Define abbreviations upon first appearance in the text.

Do not use non-standard abbreviations unless they appear at least three times in the text.

Keep abbreviations to a minimum.

References tyle

PLOS uses "Vancouver" style, as outlined in the ICMJE sample references.

See reference formatting examples and additional instructions below.

Manuscript Organization

Manuscripts should be organized as follows. Instructions for each element appear below the list.

Beginning section: *The following elements are required, in order:*

- Title page: List title, authors, and affiliations as first page of the manuscript
- Abstract
- Introduction

Middle section: *The following elements can be renamed as needed and presented in any order:*

- Materials and Methods
- Results
- Discussion
- Conclusions (optional)

Ending section: *The following elements are required, in order:*

- Acknowledgments
- References
- Supporting information captions (if applicable)

Other elements:

- Figure captions are inserted immediately after the first paragraph in which the figure is cited.
- Figure files are uploaded separately.
- Tables are inserted immediately after the first paragraph in which they are cited.
- Supporting information files are uploaded separately.

Parts of a Submission

Title: Include a full title and a short title for the manuscript.

Full title: length – 200 characters; guidelines - Specific, descriptive, concise, and comprehensible to readers outside the field.

Short title: length – 70 characters; guidelines - State the topic of the study.

Titles should be written in sentence case (only the first word of the text, proper nouns, and genus names are capitalized). Avoid specialist abbreviations if possible. For clinical trials, systematic reviews, or meta-analyses, the subtitle should include the study design.

Author list

Authorship requirements

- All authors must meet the criteria for authorship as outlined in the authorship policy. Those who contributed to the work but do not meet the criteria for authorship can be mentioned in the Acknowledgments. Read more about Acknowledgments.
- The corresponding author must provide an ORCID iD at the time of submission by entering it in the user profile in the submission system. Read more about ORCID.

Author names and affiliations

- Enter author names on the title page of the manuscript and in the online submission system.
- On the title page, write author names in the following order:
  First name (or initials, if used)
  Middle name (or initials, if used)
  Last name (surname, family name)
- Each author on the list must have an affiliation. The affiliation includes department, university, or organizational affiliation and its location, including city, state/province (if applicable), and country. Authors have the option to include a current address in addition to the address of their affiliation at the time of the study. The current address should be listed in the byline and clearly labelled "current address." At a minimum, the address must include the author's current institution, city, and country.
- If an author has multiple affiliations, enter all affiliations on the title page only. In the submission system, enter only the preferred or primary affiliation. Author affiliations will be listed in the typeset PDF article in the same order that authors are listed in the submission.
- Author names will be published exactly as they appear in the manuscript file. Please double-check the information carefully to make sure it is correct.

Corresponding author

- The submitting author is automatically designated as the corresponding author in the submission system. The corresponding author is the primary contact for the journal office and the only author able to view or change the manuscript while it is under editorial consideration.
- The corresponding author role may be transferred to another coauthor. However, note that transferring the corresponding author role also transfers access to the manuscript. (To designate a new corresponding author while the manuscript is still under consideration, watch the video tutorial below.)
- Only one corresponding author can be designated in the submission system, but this does not restrict the number of corresponding authors that may be listed on the article in the event of publication. Whoever is designated as a corresponding author on the title page of the manuscript file will be listed as such upon publication. Include an email address for each corresponding author listed on the title page of the manuscript.

Consortia and group authorship

- If a manuscript is submitted on behalf of a consortium or group, include its name in the manuscript byline. Do not add it to the author list in the submission system. You may include the full list of members in the acknowledgments or in a supporting information file.
- PubMed only indexes individual consortium or group author members listed in the article byline. If included, these individuals must qualify for authorship according to our criteria (read the group authorship policy).

Author contributions

- Provide at minimum one contribution for each author in the submission system. Use the CRediT taxonomy to describe each contribution. Read the policy and the full list of roles.
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Acknowledgments

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Source	Format
Published articles	Hou WR, Hou YL, Wu GF, Song Y, Su XL, Sun B, et al. cDNA, genomic sequence cloning and overexpression of ribosomal protein gene L9 (rpL9) of the giant panda (Ailuropoda melanoleuca). Genet Mol Res. 2011;10: 1576-1588. Devaraju P, Gulati R, Antony PT, Mithun CB, Negi VS. Susceptibility to SLE in South Indian Tamils may be influenced by genetic selection pressure on TLR2 and TLR9 genes. Mol Immunol. 2014 Nov 22. pii: S0161-5890(14)00313-7. doi: 10.1016/j.molimm.2014.11.005. **Note**: A DOI number for the full-text article is acceptable as an alternative to or in addition to traditional volume and page numbers. When providing a DOI, adhere to the format in the example above with both the label and full DOI included at the end of the reference (doi: 10.1016/j.molimm.2014.11.005). Do not provide a shortened DOI or the URL.
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Online articles	Huynen MMTE, Martens P, Hilderlink HBM. The health impacts of globalisation: a conceptual framework. Global Health. 2005;1: 14. Available from: http://www.globalizationandhealth.com/content/1/1/14
Books	Bates B. Bargaining for life: A social history of tuberculosis. 1st ed. Philadelphia: University of Pennsylvania Press; 1992.
Book chapters	Hansen B. New York City epidemics and history for the public. In: Harden VA, Risse GB, editors. AIDS and the historian. Bethesda: National Institutes of Health; 1991. pp. 21-28.
Deposited articles (preprints, e-prints, or arXiv)	Krick T, Shub DA, Verstraete N, Ferreiro DU, Alonso LG, Shub M, et al. Amino acid metabolism conflicts with protein diversity. arXiv:1403.3301v1 [Preprint]. 2014 [cited 2014 March 17]. Available from: https://128.84.21.199/abs/1403.3301v1 Kording KP, Mensh B. Ten simple rules for structuring papers. BioRxiv [Preprint]. 2016 bioRxiv 088278 [posted 2016 Nov 28; revised 2016 Dec 14; revised 2016 Dec 15; cited 2017 Feb 9]: [12 p.]. Available from: https://www.biorxiv.org/content/10.1101/088278v5 doi: 10.1101/088278
Published media (print or online newspapers and magazine articles)	Fountain H. For Already Vulnerable Penguins, Study Finds Climate Change Is Another Danger. The New York Times. 2014 Jan 29 [Cited 2014 March 17]. Available from: http://www.nytimes.com/2014/01/30/science/earth/climate-change-taking-toll-on-penguins-study- finds.html
New media (blogs, web sites, or other written works)	Allen L. Announcing PLOS Blogs. 2010 Sep 1 [cited 17 March 2014]. In: PLOS Blogs [Internet]. San Francisco: PLOS 2006 - . [about 2 screens]. Available from: http://blogs.plos.org/plos/2010/09/announcing-plos-blogs/.
Masters' theses or doctoral dissertations	Wells A. Exploring the development of the independent, electronic, scholarly journal. M.Sc. Thesis, The University of Sheffield. 1999. Available from: http://cumincad.scix.net/cgi-bin/works/Show?2e09
Databases and repositories (Figshare, arXiv)	Roberts SB. QPX Genome Browser Feature Tracks; 2013 [cited 2013 Oct 5]. Database: figshare [Internet]. Available from: http://figshare.com/articles/QPX_Genome_Browser_Feature_Tracks/701214
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Appendix H: Summary table of routine vaccination among migrant populations (Source, Author)

Literature featuring routine childhood vaccination coverage and immunisation services among migrant populations			
Author, Year	**Title**	**Country/region**	**Vaccine(s) featured**
Abdi et al, 2021 Retrospective cohort study	Vaccine coverage in children born to migrant mothers in Australia: A population-based cohort study.	Australia	DTP
Ali et al, 2016 Cross-sectional survey	Childhood Immunization among Internally Displaced Persons (IDPs) Of under Five-Years from North Waziristan Agency, Pakistan: A Cross-sectional Study	Pakistan	BCG, OPV, DTP, MCV, Hep B, Hib
Babakura et al, 2021 Analysis of surveillance data	The challenges of insecurity on implementing vaccination campaign and its effect on measles elimination and control efforts: A case study of 2017/18 measles campaign in Borno state, Nigeria	Nigeria	MCV
Baptiste et al, 2021 Cross-sectional survey	Measles outbreak in complex emergency: estimating vaccine effectiveness and evaluation of the vaccination campaign in Borno State, Nigeria, 2019	Nigeria	MCV
Charania et al, 2018 Retrospective cohort study	Exploring immunisation inequities among migrant and refugee children in New Zealand	New Zealand	MMR, PCV, Pertusis, Rotavirus
Chung et al, 2016 Cross-sectional survey	Childhood immunizations in China: disparities in health care access in children born to North Korean refugees	China	BCG, DTP, HBV, MMR, IPV, VAR, JE
Gargano et al, 2017 Evaluation study	Pneumonia prevention: Cost-effectiveness analyses of two vaccines among refugee children aged under two years, Haemophilus influenzae type b-containing and pneumococcal conjugate vaccines, during a humanitarian emergency, Yida camp, South Sudan	South Sudan	Hib-containing pentavalent vaccine, DTP, Hep B, PCV
Hu et al, 2013 Cross-sectional survey	Timeliness Vaccination of Measles Containing Vaccine and Barriers to Vaccination among Migrant Children in East China	China	MCV
Hu et al, 2015 Cross-sectional survey	Comparative assessment of immunization coverage of migrant children between national immunization program vaccines and non-national immunization program vaccines in East China	China	BCG, Hep B, DTP, OPV, MCV, JEV, MPV-a, MPV-ac, Hep A, DT, IPV, VarV, Hib, ORV, PCV7
Hu et al, 2015 Evaluation study	Does introducing an immunization package of services for migrant children improve the coverage, service quality and understanding? An evidence from an intervention study among 1548 migrant children in eastern China	China	BCG, Hep B, OPV, DTP, MCV, Hep A, JEV, MPV-a, MPV-ac, DT
Hvass et al, 2020 Cross-sectional survey	Are refugees arriving in Denmark an under-immunised group for measles? A cross-sectional serology study	Denmark	MCV
Ioannidou et al, 2023 Evaluation study	Suboptimal Serologic Immunity Against Poliomyelitis Among New Migrant Children in Greece Calls for Organized Action	Greece	OPV
Jalloh et al, 2019 Qualitative study	Rapid behavioural assessment of barriers and opportunities to improve vaccination coverage among displaced Rohingyas in Bangladesh, January 2018	Bangladesh	DTP-Hep B-Hib (pentavalent), OPV, PCV
Jenness et al, 2021 Evaluation study	Measles vaccine coverage among children born to Somali immigrants in Norway	Norway	MCV

Ke et al, 2014 Cross-sectional survey	Vaccination coverage and its determinants among migrant children in Guangdong, China	China	BCG, Hep B, OPV, DPT and MCV
Kusuma et al, 2018 Cross-sectional survey	Access to childhood immunisation services and its determinants among recent and settled migrants in Delhi, India	India	OPV, BCG, DPT, MCV, Hep B
Moller et al, 2016 Retrospective cohort study	Differences in uptake of immunisations and health examinations among refugee children compared to Danish-born children: a cohort study	Denmark	DTaP-IPV, MMR
Oladeji et al, 2019 Evaluation study	Integrating immunisation services into nutrition sites to improve immunisation status of internally displaced persons' children living in Bentiu protection of civilian site, South Sudan	South Sudan	BCG, OPV, DTP-Hep B-Hib (pentavalent), MCV
Robertson et al, 2017 Cross-sectional survey	Challenges in Estimating Vaccine Coverage in Refugee and Displaced Populations: Results from Household Surveys in Jordan and Lebanon	Jordan, Lebanon	BCG, MCV, OPV DPT
Yun et al, 2016 Analysis of surveillance data	Increasing Hepatitis B Vaccine Prevalence Among Refugee Children Arriving in the United States, 2006-2012	USA	Yun et al, 2016
Zandvoort et al, 2019 Review	Pneumococcal conjugate vaccine use during humanitarian crises	Non-specific	Pneumococcal conjugate vaccine (PVC)
Literature featuring combined routine childhood and adolescent vaccination coverage and immunisation services among migrant populations			
Carreras-Abad et al, 2022 Retrospective cohort study	Health and Vaccination Status of Unaccompanied Minors After Arrival in a European Border Country: A Cross-sectional Study (2017–2020)	Spain	MMR, VAR, Hep B, Hep A
Fahrni et al, 2020 Retrospective cross-sectional study	Immunization Against Hepatitis A in Migrant Children Three Vaccination Strategies, A Retrospective Study	Switzerland	Hep A
Feldstein et al, 2018 Cross-sectional survey	Vaccination coverage survey and seroprevalence among forcibly displaced Rohingya children, Cox's Bazar, Bangladesh, 2018: A cross-sectional study	Bangladesh	MR, DT, OCV
Fozouni et al, 2019 Cross-sectional survey	Immunization coverage among refugee children in Berlin	Germany	MMR, VAR, TdaP, IPV, Hib, Hep B, Hep A; rotavirus, Men-ACYW, seasonal influenza, pneumococcal
Ganczak et al, 2021 Qualitative study	Vaccination concerns, beliefs and practices among Ukrainian migrants in Poland: a qualitative study	Poland	MCV, HPV, influenza
Ganczak et al, 2023 Qualitative study	Health System Barriers to Child Mandatory and Optional Vaccination among Ukrainian Migrants in Poland in the Context of MMR and HPV Vaccines—A Qualitative Study	Poland	MMR, HPV
Giambi et al, 2019 Cross-sectional survey	National immunization strategies targeting migrants in six European countries	Croatia, Portugal, Slovenia, Italy, Greece, Malta	BCG, DTP, IPV, Hib, HBV, MMR, PCV
Giambi et al, 2019	Immunisation of migrants in EU/EEA countries: Policies and practices	All EU/EEA countries excluding Czech Republic and Romania	BCG, DTP, IPV, Hib, HBV, MMR, PCV

Cross-sectional survey			
Gorman et al, 2019 Qualitative study	A qualitative study of vaccination behaviour amongst female Polish migrants in Edinburgh, Scotland	Scotland	Influenza & HPV
Gorman et al,2020 Qualitative study	Comparing vaccination hesitancy in Polish migrant parents who accept or refuse nasal flu vaccination for their children	Scotland	Influenza
Harmsen et al, 2015 Qualitative study	Vaccination decision-making of immigrant parents in the Netherlands; a focus group study	The Netherlands	OPV, DTP, MMR, Hib, Men C, Hep B, pneumococcal, HPV
Kaji et al, 2016 Retrospective cohort study	Immunization Coverage in Migrant School Children Along the Thailand-Myanmar Border	Thailand-Myanmar border	BCG, OPV, Hep B,
Khan et al, 2019 Cross-sectional survey	Post-vaccination campaign coverage evaluation of oral cholera vaccine, oral polio vaccine and measles–rubella vaccine among Forcibly Displaced Myanmar Nationals in Bangladesh	Bangladesh	MR, OPV, OCV
Korave at al, 2021 Analysis of surveillance data	Internal displacement; an impediment to the successful implementation of planned measles supplemental activities in Nigeria, a case study of Benue State	Nigeria	MCV
Mellou et al, 2019 Cross-sectional survey	Increasing childhood vaccination coverage of the refugee and migrant population in Greece through the European programme PHILOS, April 2017 to April 2018	Greece	MMR, DTP, OPV, Hep B, Hib, pneumococcal
Nakken et al, 2018 Analysis of routinely collected data	Vaccination status and needs of asylum-seeking children in Denmark: a retrospective data analysis	Denmark	DTaP/IPV/Hib, PCV, MMR, HPV
Navarro-Colorado et al, 2014 Analysis of routinely collected data	Measles Outbreak Response Among Adolescent and Adult Somali Refugees Displaced by Famine in Kenya and Ethiopia, 2011	Kenya, Ethiopia	MCV
Perry et al, 2020 Analysis of routinely collected data	Inequalities in vaccination coverage and differences in follow-up procedures for asylum-seeking children arriving in Wales, UK	Wales	DTaP/IPV/Hib, MMR, Men C, Men ACWY
Literature featuring combined routine childhood, adolescent and adult vaccination coverage and immunisation services among migrant populations			
Deal et al, 2022 Retrospective cross-sectional study	Immunisation status of UK-bound refugees between January 2018, and October 2019: a retrospective, population-based cross-sectional study	UK	IPV, MMR, DTP, Hep B, Rotavirus, VAR, Hib, pneumococcus, meningococcus
Dinleyici et al, 2020 Review	Meningococcal infections among refugees and immigrants: silent threats of past, present and future	Non-specific	Meningococcal
Joo et al, 2018 Retrospective cross-sectional study	A comparative cost analysis of the Vaccination Program for US-bound Refugees	USA	Hep B, DTP, Td, Hib, Pentavalent (HepB-Hib-DTP), OPV, MMR
Meteke et al, 2020	Delivering infectious disease interventions to women and children in conflict settings: a systematic review	Non-specific	Polio, measles, cholera, DTP,

Review			meningitis, TB, malaria, Hep B
Pezzi et al, 2018 Analysis of routinely collected data	Vaccine delivery to newly arrived refugees and estimated costs in selected U.S. clinics, 2015	USA	Hep B, DTP, Td, Hib, MMR, OPV, Pentavalent (HepB-Hib-DTP)
Reardon et al, 2019 Analysis of routinely collected data	Cost-effectiveness of birth-dose hepatitis B vaccination among refugee populations in the African region: a series of case studies	Africa	Hep B

(BCG - Bacille Calmette-Guérin; DT - diphtheria-tetanus; DTP – diphtheria-tetanus-pertussis; DTP-Hep B-Hib (pentavalent) - diphtheria-tetanus-pertussis-hepatitis B-Haemophilus influenzae type b vaccine (pentavalent); HBV - Hepatitis B virus; Hep A – Hepatitis A; Hep B - Hepatitis B; Hib - haemophilus influenzae type b; HPV - human Papillomavirus; IPV – inactivated poliovirus vaccine; JE - Japanese encephalitis; MCV - measles containing vaccines; Men C – meningococcal serogroup C; Men ACWY - Meningococcal serogroups A, C, W and Y; MMR – measles, mumps and rubella; MPV-a - meningococcal polysaccharide vaccine type a; MPV-ac - meningococcal polysaccharide vaccine type a and c; OPV - oral polio vaccine; ORV – oral rotavirus vaccine; PCV - pneumococcal conjugate vaccine TdaP - Tetanus, diphtheria & acellular pertussis vaccine, adult/adolescent formulation)

Appendix I: Summary table of routine vaccination among adolescent migrants (Source, Author)

Author, Year	Title	Vaccine(s) featured	Country/Region	Key findings
Allen et al, 2019 Qualitative	Facilitators and Barriers of Cervical Cancer Screening and Human Papilloma Virus Vaccination Among Somali Refugee Women in the United States: A Qualitative Analysis	HPV	USA	Findings: 58% of children not received HPV vaccination (HPVV); 26% vaccinated, HPVV status of 16% of children unknown; 77% of mothers unvaccinated; Mothers assumed responsibility for HPVV of their children, but majority also noted that doctors' and family members were influential in HPVV-related decisions; Women recommended oral, community-based HPV dissemination forums to alleviate information gaps.
Ayash et al, 2022 Cross-sectional survey	Arab American Mothers' HPV Vaccination Knowledge and Beliefs	HPV	USA	Low overall HPV uptake in general population; lower among the study group. Over two thirds (63.5%) of the children had not received HPVV. Barriers - deficient HPV knowledge (67.3%); HPV vaccine not recommended for their child by health providers (59.4%); language barriers; Facilitators: health provider recommendation; higher education among mothers; being from higher income households; Christian religious affiliation; duration of stay in the USA - longer stay associated with increased uptake of HPVV.
Berman et al, 2017 Analysis of routinely collected data	"Giving It Our Best Shot? Human Papillomavirus and Hepatitis B Virus Immunization Among Refugees, Massachusetts, 2011–2013	HPV	USA	Variations: gender - female refugees more likely to get HPVV than males; age - likelihood of HPVV was more in the 9–12-year-old refugees compared to the 13-26-year-olds; geographical - refugees from SSA more likely to get HPVV than those from other regions, with the exception of Somalis. In the 13-17 age group, refugees had higher rates of first HPVV dose compared to US adolescents in the same age group.
Bhatta et al, 2020 Cross-sectional survey	Cervical Cancer and Human Papillomavirus Vaccine Awareness Among Married Bhutanese Refugee and Nepali Women in Eastern Nepal	HPV	Nepal	Minimal differences in levels of HPVV and cervical cancer awareness between Bhutanese refugee and Nepali women; significant association was found between no formal education and limited cervical cancer awareness AND lack of knowledge about STIs and HPVV.
Chen et al, 2022 Evaluation study	A Digital Storytelling Intervention for Vietnamese American Mothers to Promote Their Children's HPV Vaccination	HPV	USA	Post-intervention - increase in behavioural intent from 53-74%; OR indicative of statistical significance (OR = 9.12; Cohen g = 0.40). Quality content rating of digital narratives high, indicating that the stories resonated well with the mothers.
Chu et al, 2021 Evaluation study	The impact of an educational forum intervention on East African mothers' HPV vaccine-related knowledge, attitudes, and intentions to vaccinate their adolescent children	HPV	USA	Pre- to post- intervention changes were significant: perceived ability to decide on vaccination based on knowledge of HPVV - pre-intervention = 12%; post-intervention = 90%; intent to vaccinate children 'very likely' - pre-intervention = 16%; post-intervention = 83%. Actual behaviour – only 2 mothers vaccinated their children within 6 months of the intervention.
Colon-Lopez, 2015 Cross-sectional survey	HPV Awareness and Vaccine Willingness Among Dominican Immigrant Parents Attending a Federal Qualified Health Clinic in Puerto Rico	HPV	Puerto Rico	Overall, high level of HPV awareness (91.7%), including HPVV for males (55%), but low HPVV coverage (31.7%); over 55% not discussed HPVV with health providers and not been advised to vaccinate their sons; 83% indicated willingness to vaccinate sons within the following year.
Dailey & Krieger, 2017 Qualitative study	Communication and US-Somali Immigrant Human Papillomavirus (HPV) Vaccine Decision-Making	HPV	USA	Barriers to HPVV included: framing of HPVV as endorsement of pre-marital sexual activity as different from HPVV as health promotion; inadequate information about HPVV efficacy and possible side effects. Responsibility for health-related decisions of children and adolescents rests solely on parents are primary caregivers in Somali culture; clinicians play a key role as health-system mediators in shaping vaccine uptake by providing information and endorsing HPVV.

Ko et al, 2019 Qualitative study	"We brought our culture here with us": A qualitative study of perceptions of HPV vaccine and vaccine uptake among East African immigrant mothers	HPV	USA	Barriers - negative views and mistrust of vaccines based on previous experiences in home countries, including cultural and religious beliefs e.g. HPVV being a form of sterilisation, a licence for pre-marital sex and/or HPVV contains pork gelatine; apprehension regarding possible side effects; limited information about HPVV; suspicion around non-compulsory vaccines including HPVV. Facilitators: recommendations by health providers; health providers from similar ethnic communities; community-based information sharing via interpersonal and media channels e.g., DVDs and venues e.g., churches and community centres.
Lindsay et al, 2020 Cross-sectional survey	Central American Immigrant Parents' Awareness, Acceptability, and Willingness to Vaccinate Their Adolescent Children Against Human Papillomavirus: A Pilot Cross-Sectional Study	HPV	USA	Overall knowledge of HPV among parents was 75%, with higher knowledge and acceptability among mothers (87.5%) compared to fathers (58.3%); one dose coverage among children was 85.7% ; 90% of parents of unvaccinated children could consider HPVV for their adolescents if advised to do so by a health practitioner.
McComb et al, 2018 Qualitative study	Knowledge, Attitudes and Barriers to Human Papillomavirus (HPV) Vaccine Uptake Among an Immigrant and Refugee Catch-Up Group in a Western Canadian Province	HPV	Canada	Adolescent girls and young women participants (16-26 years) acknowledged the importance of HPV and cervical cancer prevention and the efficacy of HPVV but none had been vaccinated. Main barriers - insufficient information about HPV and low perceived risk of HPV infection and cervical cancer; facilitator - doctor's recommendation linked to willingness to receive HPVV.
Moller et al, 2018 Retrospective cohort study	Human papillomavirus immunization uptake among girls with a refugee background compared with Danish-born girls: a national register-based cohort study	HPV	Denmark	Significantly fewer refugee girls had received HPVV compared to Danish-born girls, with lower uptake among the former compared to the latter. Link between period of residence in Denmark, socio-economic status, and HPV vaccination uptake: girls who had resided in Denmark longer showed higher the likelihood of HPV vaccination; girls from higher income families were more likely to be vaccinated against HPV than those from lower income families.
Napolitano et al, 2018 Cross-sectional survey	Knowledge and attitudes toward HPV infection and vaccination among immigrants and refugees in Italy	HPV	Italy	Low pre-survey HPV knowledge (15.9%); facilitators of uptake - increased likelihood of prior HPV infection knowledge among: those from Eastern Europe, Asia and South America; gender - females; place of residence - home rather than on street; more educated; only 3% had received HPVV. Limited knowledge (below 50%) was a major barrier in acceptance and uptake of HPVV; information from several trusted sources e.g., health professionals, family members and friends were deemed effective in HPV-related information dissemination.
Netfa et al, 2020 Review	Knowledge, Attitudes and Perceptions of Immigrant Parents Towards Human Papillomavirus (HPV) Vaccination: A Systematic Review	HPV	Several	Globally, national HPVV programs exist in over 80 countries; early initiators of HPVV include USA, Canada, Australia, and the UK. Increase in HPV unvaccinated migrants from LMICs to HICs raises the need to research on HPVV uptake amongst migrant populations. Need for HPVV-related health promotional interventions to increase knowledge and awareness of HPVV among migrant parents as custodians of children and adolescents
Painter et al, 2019 Qualitative study	Vaccine-related attitudes and decision-making among uninsured, Latin American immigrant mothers of adolescent daughters: a qualitative study	TdaP, Men ACWY, HPV	USA	Vaccine coverage among adolescents in the general population is below optimal levels and particularly for HPVV; coverage among Hispanic populations is lower than that in the general population partly due to structural impediments e.g. legal status, no medical insurance and poverty. Key facilitators: media messaging, school mandate; doctors' advice; key role of mothers in vaccine-related decision-making for their children underscored.
Rubens-Augustson et al, 2019 Qualitative study	Healthcare provider perspectives on the uptake of the human papillomavirus vaccine among newcomers to Canada: a qualitative study	HPV	Canada	In 2019, average HPVV uptake in general population in Canada was 56% i.e., less than national target of 80% coverage. HPVV uptake below that of other routine childhood vaccinations. Health providers' views on barriers: inaccessibility due to cost and unfamiliarity with the healthcare system; communication barriers akin to language; insufficient knowledge

				on HPVV; cultural barriers related to taboos around conversations on sexuality and pre-marital sex; provider-related constraints - limited time to address preventive health measures like HPVV, limited capacity and resources to administer multiple doses. Facilitators: cost subsidisation/flexibility in payment for vaccination; health promotion directed at specific stakeholders e.g., parents; fostering trust in the healthcare system; culturally appropriate dissemination strategies.
Stephens & Thomas, 2013 Qualitative	Cultural Values Influencing Immigrant Haitian Mothers' Attitudes Toward Human Papillomavirus Vaccination for Daughters	HPV	USA	Barriers: low HPV-related knowledge; cultural perspectives e.g., reticence to discuss sex-related issues with daughters; conflation of consent to vaccination as endorsement of pre-marital sex for adolescent daughters and confusion between HIV and HPV. Facilitators: health provider encouragement/advice.
Taylor et al, 2014 Cross-sectional survey	Understanding HPV Vaccine Uptake Among Cambodian American Girls	HPV	USA	Uptake: 29% of daughters received one dose of HPVV; 14% completed the HPVV schedule. Facilitators: information about HPVV communicated by health provider; mothers who had recently undergone a Pap Test. Barriers: lack of information and knowledge about HPVV leading to minimisation of HPVV; lack of physician recommendation.
Vu et al, 2022 Cross-sectional survey	U.S. Vietnamese Mothers' HPV Vaccine Decision-Making for Their Adolescents: A Qualitative Study	HPV	USA	P3 model of influencers: practice-level- usefulness of health promotion information provided in clinics; re-scheduling HPVV appointments and not receiving reminders for subsequent doses; provider-level - lack of or poor health provider communication regarding HPVV options; trust in health providers; follow-up on patients' post-acceptance behaviour e.g. immediate or delayed HPVV; patient-level - limited knowledge about HPVV, including not exclusively for girls, procrastination for various reasons including child not sexually active yet, need more time to understand HPVV-related information so as to facilitate informed consent, ranking of HPVV as lower in priority than other vaccines, low priority accorded to preventive vaccines, uncertainty about HPVV safety.

(HPV - human Papillomavirus; Men ACWY - Meningococcal serogroups A, C, W and Y; TdaP - Tetanus, diphtheria & acellular pertussis vaccine, adult/adolescent formulation)

Appendix J: JBI critical appraisal checklist for qualitative research

Reviewer_ _ _ _ _____Date_____

Author_____Year_____ Record Number_____

		Yes	No	Unclear	Not applicable
1.	Is there congruity between the stated philosophical perspective and the research methodology?	☐	☐	☐	☐
2.	Is there congruity between the research methodology and the research question or objectives?	☐	☐	☐	☐
3.	Is there congruity between the research methodology and the methods used to collect data?	☐	☐	☐	☐
4.	Is there congruity between the research methodology and the representation and analysis of data?	☐	☐	☐	☐
5.	Is there congruity between the research methodology and the interpretation of results?	☐	☐	☐	☐
6.	Is there a statement locating the researcher culturally or theoretically?	☐	☐	☐	☐
7.	Is the influence of the researcher on the research, and vice- versa, addressed?	☐	☐	☐	☐
8.	Are participants, and their voices, adequately represented?	☐	☐	☐	☐
9.	Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	☐	☐	☐	☐
10.	Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

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Appendix K: JBI critical appraisal checklist for cross-sectional studies

Reviewer_____Date_____

Author_____Year_____ Record Number_____

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☐	☐	☐	☐
2. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	☐	☐	☐	☐
5. Were confounding factors identified?	☐	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

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Appendix L: JBI critical appraisal checklist for cohort studies

Reviewer_____Date_____

Author_____Year_____ Record Number_____

	Yes	No	Unclear	Not applicable
1. Were the two groups similar and recruited from the same population?	☐	☐	☐	☐
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	☐	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	☐	☐	☐	☐
4. Were confounding factors identified?	☐	☐	☐	☐
5. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	☐	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	☐	☐	☐	☐
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	☐	☐	☐	☐
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	☐	☐	☐	☐
10. Were strategies to address incomplete follow up utilized?	☐	☐	☐	☐
11. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

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Appendix M: Mixed Methods Appraisal Tool (MMAT) 2018

Category of study designs	Methodological quality criteria	Responses			
		Yes	No	Can't tell	Comments
Screening questions (for all types)	S1. Are there clear research questions?				
	S2. Do the collected data allow to address the research questions?				
	Further appraisal may not be feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.				
1. Qualitative	1.1. Is the qualitative approach appropriate to answer the research question?				
	1.2. Are the qualitative data collection methods adequate to address the research question?				
	1.3. Are the findings adequately derived from the data?				
	1.4. Is the interpretation of results sufficiently substantiated by data?				
	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?				
2. Quantitative randomized controlled trials	2.1. Is randomization appropriately performed?				
	2.2. Are the groups comparable at baseline?				
	2.3. Are there complete outcome data?				
	2.4. Are outcome assessors blinded to the intervention provided?				
	2.5 Did the participants adhere to the assigned intervention?				
3. Quantitative non-randomized	3.1. Are the participants representative of the target population?				
	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?				
	3.3. Are there complete outcome data?				
	3.4. Are the confounders accounted for in the design and analysis?				
	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?				
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the research question?				
	4.2. Is the sample representative of the target population?				
	4.3. Are the measurements appropriate?				
	4.4. Is the risk of nonresponse bias low?				
	4.5. Is the statistical analysis appropriate to answer the research question?				
5. Mixed methods	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?				
	5.2. Are the different components of the study effectively integrated to answer the research question?				
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?				
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?				
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?				