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# How community engaged practices are applied in interventions promoting human papillomavirus (HPV) vaccination for culturally and linguistically diverse (CALD) children and adolescents: a systematic review

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## ABSTRACT

**Background:** Effective vaccines for human papillomavirus (HPV) are readily available but culturally and linguistically diverse (CALD) communities experience vaccination disparities. Whilst community engaged (CE) practices are recommended, we know little about this practice in local settings.

**Aim:** We aim to compare CE practices within HPV vaccination interventions targeting CALD children aged 9–17 years and identify how CE elements are linked to outcomes.

**Method:** Included interventions targeted vaccine eligible CALD children, their parents/caregivers, or health professionals servicing CALD populations. We searched six databases for studies published between 2006 and April 2024. We critically appraised included studies, and data was synthesised based on a CE health framework.

**Results:** We screened 3798 articles to identify 22 studies. Interventions were based in the United States (USA) and targeted nine different CALD communities. CE practice varied across interventions. All CE practices improved vaccine knowledge, but only multi-component, peer-led/delivered CE practice improved series completion. We note several confounders and analysis limitations.

**Discussion:** Most CE approaches were initiated by health services rather than the local community. All interventions were limited by study bias and reporting details. We experienced difficulties linking CE practice to intervention outcomes, highlighting tensions between health service driven CE and community empowered CE practices.

## ARTICLE HISTORY

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## KEYWORDS

Review; culturally and linguistically diverse; human papillomavirus; vaccination; community engaged practice; interventions

## SUSTAINABLE DEVELOPMENT GOALS

SDG 5: Gender equality; SDG 10: Reduced inequalities

## 1. Introduction

Safe and highly effective vaccines for common human papillomavirus (HPV) types have been available since 2006 but many countries report low or modest vaccine uptake in

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children and adolescents (herein both referred to as children) (Bruni et al. 2021). Internationally those who identify as ethnically, racially, culturally, and linguistically diverse (herein all referred to as CALD) experience lower series completion in HPV vaccination due to a range of barriers (Charania et al. 2019; Drolet et al. 2016; Fernández de Casadevante, Gil Cuesta, and Cantarero-Arévalo 2015; Spencer, Calo, and Brewer 2019) and these health inequities must be addressed for countries to achieve 90% HPV vaccination coverage by 2030 (World Health Organization 2020). As every CALD community and their health needs are unique (Charania et al. 2019) the World Health Organisation (WHO) recommends conducting community engaged (CE) research to tailor immunisation interventions for underserved communities (TIP (Tailoring Immunization Programmes) 2019; World Health Organization 2020).

However, CE has a broad range of practices and underpinning philosophies (O'Mara-Eves et al. 2013), can be time and resource intensive (Hammanero et al. 2018) and shows variable and inconsistent results (Jain et al. 2022). Clarity is needed then around what CE practices impact vaccination outcomes in CALD contexts and settings.

### **1.1. Aims and objectives of review**

To our knowledge, this is the first review to assess the implementation of CE practices in interventions aiming to improve HPV vaccination uptake, completion, intention, or knowledge for CALD children aged 9–17 years old. As such, this review aims to answer the following questions:

1. How have CE practices been implemented within CALD interventions to impact childhood HPV vaccination uptake, completion, intention, or knowledge and how is this reported in the academic literature?
2. What CE practices in CALD community settings are associated with improved HPV vaccination uptake, completion, intention, or knowledge?

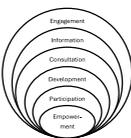
## **2. Materials**

Our search strategy identified published peer-reviewed studies in PubMed, Web of Science, Medline Full Text, CINAHL and Scopus. We developed a research protocol (unregistered, available in the Supplementary Materials) and consulted with a librarian from our university about our search strategy. Keywords and indexed terms came from O'Mara-Eves previous CE review (O'Mara-Eves et al. 2013) and our full keyword terms are available in the Supplementary Materials. We also screened reference lists of included studies, conducted a hand search of known articles, and performed a reverse citation search of included and known CE research studies.

### **2.1. Inclusion/exclusion criteria**

For inclusion in our review, the interventions had to: describe a CE practice (Table 1), take place in a country where HPV vaccination is part of the routine adolescent immunisation schedule, and that interventions targeted one, or a combination, of: (1) CALD children aged 9–17 years old eligible for HPV vaccination; (2) CALD parents/guardians/caregivers

**Table 1.** Definitions, categorisations and conceptualisation of community engagement (CE) used in this review.

Term	Definition	Example
<i>Community engagement (CE)</i>	'a continuum of approaches to engaging communities of place and/or interest in activities aimed at improving population health and/or reducing health inequalities.' (O'Mara-Eves et al. 2013, 112)	 <p>Source of image: O'Mara-Eves et al. (2013, 47) – produced with permission as long as suitable acknowledgement is made and not associated with advertising.</p>
<i>Engagees or community partners (partners)</i>	The individuals or organisations from the target community who are involved with some aspect of intervention development, design, or implementation; and are distinct and separate from the participants who receive the intervention (O'Mara-Eves et al. 2013). Typically, these individuals are also located outside of academic research (O'Mara-Eves et al. 2015).	Community leaders, members of local community organisations, local community members, government workers, community, or professional healthcare workers.
<i>Guide to Community engagement (CE) practices and predicted outcomes</i> (O'Mara-Eves et al. 2013, 123)	<ol style="list-style-type: none"> <li><i>CE for patient/consumer involvement and to enhance services:</i> This CE empowers communities (or members of communities') to be involved in strategies leading to a CE outcome of sustainable changes in services or service development (outcome). The need for ongoing CE will depend on the nature of the changes made but may not be necessary for sustaining outcomes.</li> <li><i>CE for peer or lay delivered interventions:</i> When services use CE to engage and empower communities or individuals to deliver interventions directly to the community. Empowerment occurs in upskilling community members to deliver these interventions, with an outcome of sustainable behaviour change amongst themselves and the individuals taking part in the intervention. Whilst the individual changes may be sustainable and effective, the intervention needs ongoing investment from services to maintain outcomes across generations.</li> <li><i>CE to reduce health inequities:</i> When CE is used for community development. This leads to outcomes like community empowerment and collective action. This collective action allows community members to mobilise their own resources to make sustainable changes within the community. An empowered community can do much to sustain their own efforts.</li> </ol>	<p><b>Health Service Driven CE -</b> Consulting with patients to choose the most appropriate treatment, improve treatment delivery, patient experiences, and patient outcomes. This also includes working with partners to develop culturally appropriate materials and gain community member 'buy in' to tackle the issue. Communities tend to have little influence on the development, management, and evaluation of an initiative (O'Mara-Eves et al. 2013, 48)</p> <p><b>Health Service Driven CE -</b> Peers/lay people who are immersed within the community deliver the intervention. They are seen as more credible and can communicate more effectively and persuasively than individuals less immersed in the community. Typically, partners are not involved in intervention design or evaluation (O'Mara-Eves et al. 2013, 48–49).</p> <p><b>Community Driven CE -</b> Community based participatory research (CBPR) integrates multiple principles which aim to: recognise community as a unit of identify, build on the strengths and resources currently within the community, facilitates equitable partnerships and power sharing in all research phases promotes co-learning, find a balance between research and action for mutual partnership benefits, attends to the multiple detriments of health and disease, the partnership develops cyclical and iterative processes, disseminates findings and knowledge to all partners, commits to long-term process and sustainability of partnerships (O'Mara-Eves et al. 2015).</p>

Source: O'Mara-Eves et al. (2013) and O'Mara-Eves et al. (2015).

consenting to a child's vaccination; and/or (3) Stakeholders (i.e. healthcare professionals/community workers/policy-decision makers/community leaders) providing health services to CALD community members. To address known vaccine barriers related to cost (TIP (Tailoring Immunization Programmes) 2019), we also limited the review to interventions where HPV vaccination was provided to participants with no out of pocket costs. Studies also had to measure one or more outcomes related to HPV vaccination knowledge, intent, acceptability, initiation, completeness, uptake, and/or coverage.

To identify CALD communities, we modified the current CALD standards released by the Australian Bureau of Statistics (ABS) (2022). The core standards include place of birth, having a main language other than English spoken at home, and proficiency in spoken English (Australian Bureau of Statistics 2022). To be inclusive of international definitions we also recognised terms like ethnicity, race, minority ethnic group or a named cultural background (e.g. African American, Asian, Hispanic) (Pham et al. 2021). We also limited the review to non-Indigenous CALD populations as we recognise that Indigenous populations have significantly different needs and experiences compared to non-Indigenous CALD populations (Pham et al. 2021).

We also limited studies to primary research findings, publication in English, by year (as 2006 was the earliest year a country could have included HPV vaccination on an immunisation schedule), and reporting extractable or disaggregated CALD data.

## **2.2. Study selection & data extraction**

KP used Endnote software (version x9.9) to independently search, retrieve, and screen all article titles and abstracts. All authors reviewed and approved the articles identified for full-text review. KP also critically assessed all full-text articles and conducted the data extraction (Microsoft Excel). The other authors conducted a 10% independent secondary screen, critical assessment, and data extraction. We reviewed the final list of articles and discussed any disagreements until consensus.

Extraction was initially guided by an 'a priori' table (see Supplementary Materials) which was modified and revised. Table 3 includes the final extraction categories.

We defined an intervention participant as any person who was the target of the intervention. We considered any missing data or information not reported. One study did not provide an exact number of CALD participants, so we assumed this number by the 'country of birth' or 'language other than English' data (whichever was highest).

## **2.3. Risk of bias (quality assessment)**

All articles were critically appraised using the validated Meta-tool for quality appraisal of public health evidence (MetaQa) and were at risk for multiple biases (Rosella et al. 2016) (Table 3). Due to the low number of studies, none were excluded from this review.

## **2.4. Data synthesis: conceptualising and defining community engaged (CE) research**

To report and assess the full spectrum of CE approaches our analysis was guided by the O'Mara-Eves et al. (2013) CE definition (Table 1) and CE health framework (Table 2)

**Table 2.** Summary of O'Mara-Eves et al.'s CE framework (2013, 112–115).

Summary of each O'Mara-Eves et al.'s CE framework item (O'Mara-Eves et al. 2013, 112–115)	How we applied the framework
<p>1. A community is defined (by borders, identity, or shared experience) and a need (felt, expressed, comparative or normative) is identified by a group of individuals (i.e. population groups, communities or health systems).</p>	<p><b>Definition of target community</b></p> <ul style="list-style-type: none"> <li>• What criteria is defining the target communities and their health needs and who is defining the community (community outsiders or insiders)?</li> </ul>
<p>2. Identify factors that motivate researchers and partners to participate/accept invitations to be part of CE research (i.e. personal gain, public duty, improve services, etc).</p> <p>3. Determine the extent of community participation (i.e. consultants vs collaborators vs partners). Example 1. Empowerment CE practice is associated with the target community defining their community, defining their own felt health needs, reports partnership motivations related to social justice, and high involvement and empowerment of partners throughout all intervention phases. Example 2. When community outsiders control the CE practice they tend to define health needs, report their own partnership motivations, only involve partners in certain intervention phases (like recruitment or delivery).</p>	<p><b>Definition of health needs</b></p> <ul style="list-style-type: none"> <li>• Normative – comparing living conditions with a general social norm or standard (usually defined by outsiders)</li> <li>• Comparative – comparing service use of one community to another community (usually defined by outsiders)</li> <li>• Expressed health needs – the community's use of services (defined by outsiders or insiders)</li> <li>• Felt – community members identifying their own needs (defined by insiders)</li> <li>• Do researchers and partners report their motivations to be involved in CE practice (e.g. personal, communal, or societal gains)?</li> <li>• How is this linked to the type of CE practiced (Table 1) and how partners contribute?</li> <li>• Where did partners contribute to the intervention?</li> <li>• What are the links between framework points 1 and 2 and how partners participate in intervention development and implementation?</li> </ul>
<p>4. Identify the conditions, context or mediators creating the environment for CE (i.e. attitudes and trust towards each other, communication competence, funding).</p>	<ul style="list-style-type: none"> <li>• Who determined what expertise is important?</li> <li>• Who controlled the project funding?</li> <li>• Where their reports on the quality of communication between researchers and partners?</li> <li>• Did researchers and partners trust or have positive attitudes to each other?</li> <li>• What supported researcher and partner involvement in the project?</li> </ul>
<p>5. Identify the process of CE (i.e. clear objectives, time for building relationships, development of skills or training, collective decision-making, and administrative support).</p>	<ul style="list-style-type: none"> <li>• How are strength or presence of these factors linked to partnership and project outcomes?</li> <li>• How much time was given to build the partnership relationships for this project?</li> <li>• What is the degree of collective decision-making?</li> <li>• What communication processes were reported within the partnership and/or wider community?</li> <li>• How were decisions made?</li> <li>• Was their training for researchers and for partners?</li> <li>• Was project administration support available?</li> <li>• What is the project's financial stability or sustainability?</li> </ul>

6. Impact of CE (both positive and negative outcomes) for those partners who take part in the CE (direct beneficiaries) and the wider community (indirect beneficiaries) that CE interventions target. By assessing both direct and indirect impacts, we can understand if different types of CE practice are linked to better partner, individual or wider community outcomes.
- Where positive or negative effects of the CE practice on partners and the community measured or evaluated (direct impacts of CE – include improving their health outcomes, feelings of empowerment or their skills)?
  - Were positive or negative effects of the CE practice for intervention participants and the broader community measured or evaluated? (indirect positive impacts – observed by measuring intervention outcomes, improved individual and community learning, improved social capital, the continued funding of the intervention, or achieving government health targets) (Celentano et al. 2021) – indirect negative impacts include cost overruns, attrition, and partnership and community dissatisfaction (Aragones et al. 2015).
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(O’Mara-Eves et al. 2013). This definition and framework describe CE as a spectrum with the health system or service driven CE on one end and more community driven CE on the other (Cyril et al. 2015; O’Mara-Eves et al. 2013) (Table 1). By breaking down CE practices into their partnership elements, we can better understand the role that community outsiders and insiders have within CE, and link different CE practices (Table 1) to intervention outcomes.

### 3. Results

All databases were initially searched in October 2021 and updated on April 18th, 2024. The full study selection process is presented in Figure 1. A total of 3798 records were retrieved. After screening 34 titles were fully reviewed. Initially, 26 records were excluded (reasons in Figure 1). Fourteen additional records were identified through reference checks, hand searches and a reverse citation search.

Two articles were excluded after secondary screening. One did not disaggregate participant data for those who were parents/carers of children and the second did not describe a community engaged practice during intervention development. Due to the diversity of outcome measures, we did not examine the risk of bias in a sensitivity analysis. Instead, we present each study’s risk of bias in Table 3.

#### 3.1. General overview of included interventions

We included a total of 22 publications describing 14 interventions (Table 3) (Aragones et al. 2015; Berenson et al. 2019; Celentano et al. 2021; Chen et al. 2022, 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Hirth et al. 2019; Hirth et al. 2022; Kim et al. 2023;

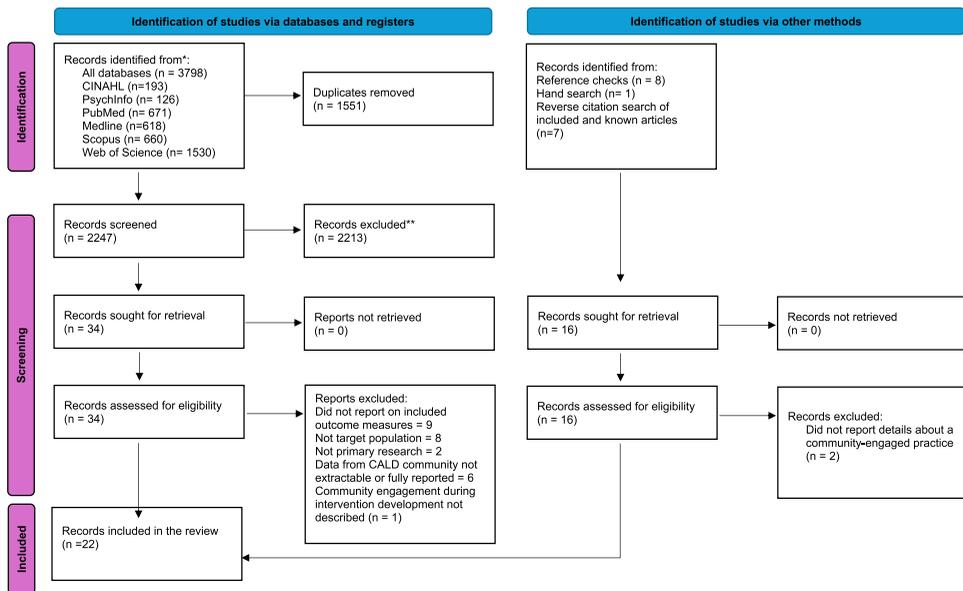


Figure 1. PRISMA flow diagram for identification of studies (Page et al. 2021).

**Table 3.** Summary of included studies.

Authors/Year/Citation	Intervention participants	Self-described community engaged approach or practice	Theoretical and behavioural frameworks applied	Intervention component(s) and Controls (if any)	Outcomes measured and reported effect(s)	Risk of bias
Aragones et al. (2015)	Mexican-American parents/caregivers ( $n = 69$ ) to vaccine – eligible adolescents.	Lay Health Community Worker delivery through a pre-established community programme	(none reported)	<p>Intervention group</p> <ul style="list-style-type: none"> <li>• Lay community health educator;</li> <li>• One-on-one health education in language;</li> <li>• Written information in language to take home;</li> <li>• Question and answer time;</li> <li>• Once a week text reminder to book future appointments;</li> <li>• Follow up phone calls.</li> </ul> <p>Control group</p> <ul style="list-style-type: none"> <li>• Same as intervention group but without weekly text reminder.</li> </ul>	<p>Vaccination initiation (1 dose)</p> <ul style="list-style-type: none"> <li>• intervention group 98% uptake, control group 88%, <math>p = 0.11</math></li> </ul> <p>Vaccination completion (3 doses)</p> <ul style="list-style-type: none"> <li>• intervention group 88% uptake, control group 40%, <math>p = 0.004</math></li> </ul>	<ul style="list-style-type: none"> <li>• Selection (Convenience sampling),</li> <li>• Confounding (Education and reminder group high vaccination outcomes)</li> <li>• Recall (self-reported vaccination)</li> </ul>
Berenson et al. (2019); Hirth et al. (2019); Hirth et al., (2022)	Hispanic ( $n = 743$ ), African American ( $n = 632$ ), and Asian ( $n = 50$ ) vaccine – eligible but unvaccinated adolescents. (Though Intervention targeted their caregiver)	Patient Navigators	<ul style="list-style-type: none"> <li>• Knowledge-To-Action (KTA) framework</li> <li>• Theory of Planned Behaviour (TPB)</li> </ul>	<p>Intervention group</p> <ul style="list-style-type: none"> <li>• Healthcare provider education;</li> <li>• Face-to-face information/personal counselling for participants;</li> <li>• Provide written health information;</li> <li>• Questions and answer opportunity;</li> <li>• On the spot vaccination;</li> <li>• Appointment scheduling and multiple reminders;</li> <li>• Opportunistic vaccination of siblings;</li> <li>• Vaccine cost covered.</li> </ul> <p>Control group (none)</p>	<p>Vaccination initiation (1 dose)</p> <ul style="list-style-type: none"> <li>• (67% uptake)</li> </ul> <p>Vaccination completion (2–3 doses depending on year recruited)</p> <ul style="list-style-type: none"> <li>• Hispanic participants 90.5% uptake, Adjusted odds ratio = 1.73 [CI: 10.92–3.23];</li> <li>• African American participants 93.2%, Adjusted odds ratio = 1.38 [CI: 10.74–2.60];</li> <li>• Asian/other participants 100% uptake. Adjusted odds ratio = not calculated</li> </ul>	<ul style="list-style-type: none"> <li>• Selection (Convenience sampling),</li> <li>• Confounding (Individual components not reported separately)</li> </ul>
Parra-Medina et al.(2015)	Mexican American caregivers ( $n = 859$ ) to vaccine – eligible but unvaccinated adolescents.	Promotores Outreach	Health Belief Model (HBM)	<p>Intervention group</p> <ul style="list-style-type: none"> <li>• Promotoras delivered face-to-face health education in language to mothers;</li> <li>• Peer educators delivered face-to-face health education to daughters</li> <li>• Question and answer time in language;</li> <li>• Written health education given out</li> <li>• Follow up call to confirm appointments or any support needed to make/go to an appointment (programme navigation)</li> <li>• Follow up to measure appointment adherence and reminders for future doses needed</li> </ul> <p>Control group (none)</p> <ul style="list-style-type: none"> <li>• Written HPV vaccine brochure handout in language.</li> </ul>	<p>Vaccination initiation (1 dose)</p> <ul style="list-style-type: none"> <li>• 84% in intervention and control groups (no significance)</li> </ul> <p>Vaccination completion (3 doses)</p> <ul style="list-style-type: none"> <li>• (Intervention: 72.2% vs Control: 42.5%, <math>p &lt; 0.001</math>; adjusted odds ratio = 2.24, <math>p = 0.01</math>)</li> </ul>	<ul style="list-style-type: none"> <li>• Selection (Convenience sampling),</li> <li>• Confounding (All participants received education and reminders)</li> <li>• Recall (Self-reported vaccination)</li> </ul>
Molokwu et al. (2019)	Mexican American female caregiver/ vaccine – eligible daughters who were partially vaccinated or unvaccinated ( $n = 372$ )	Promotores Outreach	Health Belief Model (HBM)	<p>Intervention group</p> <ul style="list-style-type: none"> <li>• Peer educators;</li> </ul>	<p>Changes pre and post-intervention survey.</p> <ul style="list-style-type: none"> <li>• Increases in parent's HPV: <ul style="list-style-type: none"> <li>○ Awareness (85.1% to 95.5%);</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Selection (Convenience sampling),</li> </ul>

(Continued)

Table 3. Continued.

Authors/Year/Citation	Intervention participants	Self-described community engaged approach or practice	Theoretical and behavioural frameworks applied	Intervention component(s) and Controls (if any)	Outcomes measured and reported effect(s)	Risk of bias
				<ul style="list-style-type: none"> <li>Face-to-face health education in language;</li> <li>Question and answer time;</li> <li>Patient navigation to clinics;</li> <li>Appointment reminder phone calls and help scheduling appointments;</li> <li>Opportunistic included any siblings who attended intervention</li> </ul> Control group (none)	<ul style="list-style-type: none"> <li>psychosocial scores</li> <li>Parents' knowledge (58.6%, <math>p &lt; 0.001</math>);</li> <li>Perceived susceptibility (7.5%, (<math>p = 0.002</math>))</li> <li>perceived benefits (2.9%, <math>p = 0.033</math>);</li> <li>vaccine intention (15.3%, <math>p &lt; 0.001</math>);</li> <li>self-efficacy (4.7%, <math>p = 0.005</math>); and</li> <li>perceived severity (2.07%, <math>p = 0.037</math>).</li> <li>Decrease in perceived barriers (<math>-9.7%</math>, <math>p &lt; 0.001</math>);</li> <li>No change in pre/post intervention subjective norms</li> </ul> Vaccination initiation (1 dose) <ul style="list-style-type: none"> <li>55%; 95%CI: 52.4.6%, 59.1% – not significant</li> </ul> Vaccination completion (3 doses) <ul style="list-style-type: none"> <li>48.7%; 95%CI: 45.3%, 52.1%; Adjusted odds ratio = 2.24 [<math>p = 0.01</math>]</li> </ul>	<ul style="list-style-type: none"> <li>Confounding (All participants exposed to all intervention components)</li> <li>Recall (Self-reported vaccination)</li> </ul>
Scarinci, Hansen, and Kim (2020)	Latinx American female caregiver/ vaccine – eligible, unvaccinated daughters ( $n = 278$ )	Lay Health Community Worker delivery	<ul style="list-style-type: none"> <li>Health Belief Model (HBM)</li> <li>PEN-3 model</li> </ul>	Intervention group <ul style="list-style-type: none"> <li>Lay/peer health educators;</li> <li>Face-to-face group health education in language;</li> <li>Question and answer time;</li> <li>Follow up questionnaires.</li> </ul> Control group <ul style="list-style-type: none"> <li>Same intervention format but different health subject.</li> </ul>	Comparing changes in mothers/daughter pre and post-intervention surveys <ul style="list-style-type: none"> <li>Perceived susceptibility to cervical cancer (intervention group: 44.8%; control group: 23.9%) and HPV infection (intervention group: 25%; control group: 3.3%)</li> <li>Perceived mother's worry about daughter future HPV infection (intervention group: 71.3%; control group: 52.1%)</li> </ul> Vaccination initiation (1 and 2 doses) <ul style="list-style-type: none"> <li>Mothers in intervention more likely to initiate vaccination (1st dose – 6 x greater odds; 2nd dose 8 x greater odds)</li> </ul> Vaccination completion (3 doses) <ul style="list-style-type: none"> <li>Mothers in intervention 16x greater odds of completing series</li> </ul> Participant intervention satisfaction: <ul style="list-style-type: none"> <li>Favourite programme: 'everything' (40%); learning about HPV vaccination (16%); learning about health in general (14%);</li> <li>Most important thing learned: HPV vaccination as a preventive strategy (37%), how-to prevent cervical cancer (31%).</li> <li>Least favourite components responses: nothing (81%)</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling),</li> <li>Confounding (Intervention components not measured separately)</li> <li>Reporting bias (no reports of negative intervention responses)</li> <li>Response bias (Participant satisfaction survey)</li> </ul>
Kepka et al. (2011, 2012)	Mexican-American female and male adolescent caregivers to mixed gendered vaccine – eligible but unvaccinated adolescents ( $n = 88$ )	Community-based collaboration	Radionovela	Intervention group <ul style="list-style-type: none"> <li>Audio narrative story in language.</li> </ul> Control group <ul style="list-style-type: none"> <li>Audio public service announcement in language.</li> </ul>	Changes in pre and post-intervention survey <ul style="list-style-type: none"> <li>Improved knowledge and beliefs (<math>p &lt; 0.050</math>)</li> <li>No statistically significant differences between the intervention and control in regard to self-efficacy for daughter to receive the HPV vaccine</li> </ul> Vaccination intention <ul style="list-style-type: none"> <li>No statistically significant differences between the intervention and control in regard to perceived likelihood of one's daughter receiving the HPV vaccine in the upcoming year.</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling),</li> <li>Recall (self-reported vaccination)</li> </ul>
Celentano et al. (2021), Chu et al. (2021), Shin et al. (2022)	East African female caregivers to unvaccinated adolescents 11–17 years. ( $n = 115$ ) (Lennon et al. 2019) and East African mixed gendered unvaccinated adolescents (14–17 years). ( $n = 136$ ) (Shin et al. 2022; Valdez et al. 2015)	Community-based collaboration/study	<ul style="list-style-type: none"> <li>Health Belief Model (HBM) [comic]</li> <li>Theory of Reasoned Action (TRA) &amp; Theory of Planned Behaviour (TPB) [adolescent intervention]</li> </ul>	Mother's Intervention group <ul style="list-style-type: none"> <li>Education delivered by a bi-cultural health professional.</li> </ul>	Changes in mother's pre/post intervention surveys [education session] <ul style="list-style-type: none"> <li>Increase in HPV related knowledge/beliefs (80.4% from 22.1%, <math>p &lt; 0.0001</math>; RR = 3.64, 95% CI: 2.89– 4.60) &amp; HPV</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling).</li> </ul>

			<ul style="list-style-type: none"> <li>Socio-Context Framework [mothers intervention]</li> <li>Andersen's Behavioural Model [mothers intervention]</li> </ul>	<ul style="list-style-type: none"> <li>Face-to-face group health education in language;</li> <li>Video story from a community member</li> </ul> <p>Adolescent Intervention group</p> <ul style="list-style-type: none"> <li>Health education comic book in English.</li> </ul> <p>Control group (none)</p>	<p>vaccination related knowledge/beliefs (66.2% from 8.2%, <math>p &lt; 0.0001</math>; RR = 8.10, 95%CI:5.26–12.45)</p> <ul style="list-style-type: none"> <li>Increase in perceived susceptibility to HPV (80.4% from 22.1%, <math>p &lt; 0.0001</math>)</li> <li>Increase in positive responses (i.e. not concerned) related to HPV vaccine's side effects (4.80 times more likely to choose positive response, 95%CI:2.65–8.69)</li> <li>Increase in positive responses to questions about social norms (RR = 3.29, 95%CI:2.38–4.55) [mothers]</li> <li>Increased willingness to vaccinate child (75.7% from 6.3%, RR = 12.00, 95%CI:5.90– 24.39) [mothers]</li> </ul> <p>Mother's intention to vaccinate child</p> <ul style="list-style-type: none"> <li>83.5% from 15.6%, <math>p &lt; 0.0001</math>, RR = 5.03, 95%CI:3.42–7.39</li> </ul> <p>Adolescent's-post intervention survey [comic book]</p> <ul style="list-style-type: none"> <li>Increase in correct HPV knowledge (66.2–84.7% from 26.6–66.7%)</li> <li>29.8% positive about comic book graphics;</li> <li>38.6% thought comic book was easy to comprehend</li> <li>50% thought length was appropriate</li> <li>97.9% noted educational value</li> <li>83.7% recognised the message that HPV vaccination is an important topic</li> <li>43.9% recognised messages about how to talk to parents</li> </ul> <p>Vaccination initiation (any doses)</p> <ul style="list-style-type: none"> <li>2% uptake</li> </ul>	<ul style="list-style-type: none"> <li>Reporting (did not report/explain negative responses about comic book)</li> <li>Confounding (All participants exposed to all intervention components)</li> </ul>
McFadden et al. (2021)	Healthcare providers ( $n = 202$ ) of East African female and male caregivers to mixed gendered adolescents.	Community-based collaboration	<ul style="list-style-type: none"> <li>Ask, Acknowledge and Advise Model</li> <li>Interdependence theory</li> </ul>	<p>Intervention group</p> <ul style="list-style-type: none"> <li>Online health professional continuing education course in English.</li> </ul> <p>Control group (none)</p>	<p>Changes in pre/post intervention surveys</p> <ul style="list-style-type: none"> <li>HPV vaccination knowledge (<math>p &lt; 0.01</math>)</li> <li>Answering cultural humility question correctly (62% compared to 51%, <math>p &lt; 0.01</math>)</li> <li>Confidence to make strong HPV vaccination recommendations for East African families (98% from 68%, <math>p &lt; 0.001</math>)</li> <li>Confidence to address vaccination concerns (97% from 94%)</li> <li>Likely or very likely to discuss vaccination with East African patients (96% from 84%)</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling).</li> </ul>
Ma et al. (2022)	Chinese-American female and male caregivers ( $n = 180$ ) to mixed gendered partially vaccinated or unvaccinated adolescents.	Community-Based Participatory Research (CBPR)	Multilevel and trauma-informed approaches (not further specified)	<p>Intervention group</p> <ul style="list-style-type: none"> <li>Two health education videos in language;</li> <li>Face to face question and answer with health educator;</li> <li>Bilingual print education materials;</li> <li>Text message appointment reminders in English and Chinese.</li> </ul> <p>Control group</p> <ul style="list-style-type: none"> <li>Same intervention format but different health subject.</li> </ul>	<p>Changes pre and post-intervention surveys</p> <ul style="list-style-type: none"> <li>Increased knowledge (<math>p &lt; 0.001</math>, Intervention: magnitude increase of 4.29 vs control magnitude increase 0.73)</li> </ul> <p>Vaccination initiation (not defined) &amp; completion (2 doses)</p> <ul style="list-style-type: none"> <li>Intervention initiation and completion 65.45% (<math>p &lt; 0.001</math>; odds of completion 485.44 times of control) vs 2.9% for control</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling),</li> <li>Confounding (All participants exposed to all intervention components)</li> <li>Recall (self-reported vaccination)</li> </ul>
Lennon et al. (2019)	African American female and male caregivers ( $n = 118$ ) to mixed gendered unvaccinated adolescents.	Community-Based Participatory Research (CBPR)	Knowledge-To-Action (KTA) framework	<p>Intervention group</p> <ul style="list-style-type: none"> <li>Opportunistic vaccination of older siblings;</li> <li>Community marketing campaign;</li> <li>Parent toolkit;</li> <li>Online health education;</li> </ul>	<p>Vaccination completion (up to date)</p> <ul style="list-style-type: none"> <li>Individual adolescent pre-intervention to post-intervention vaccination status, difference <math>p</math>-value: 25% to 46%, <math>p = 0.004</math>.</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling),</li> <li>Confounding (Separate intervention component measures not reported),</li> </ul>

(Continued)





Table 3. Continued.

Authors/Year/Citation	Intervention participants	Self-described community engaged approach or practice	Theoretical and behavioural frameworks applied	Intervention component(s) and Controls (if any)	Outcomes measured and reported effect(s)	Risk of bias
Lee et al. (2017, 2018)	Cambodian American female caregiver and unvaccinated daughter dyads. ( <i>n</i> = 19)	Community-Based Participatory Research (CBPR)	<ul style="list-style-type: none"> <li>The Storytelling Narrative</li> <li>Revised Network Episode Model (rNEM)</li> </ul>	<ul style="list-style-type: none"> <li>appointment reminders</li> <li>Control group</li> <li>City and State cohort data.</li> </ul>	<ul style="list-style-type: none"> <li>Intervention study cohort compared with the City of Milwaukee [<i>p</i> value] and State of Wisconsin [<i>p</i>-value]: 46% compared to 29% [<i>&lt;</i>0.001], 29% % [<i>&lt;</i>0.001].</li> </ul>	<ul style="list-style-type: none"> <li>Reporting bias (not reporting initiation rates).</li> </ul>
Chen, Kim, and Larkey (2019, 2022)	Vietnamese American female caregivers to mixed gendered vaccine – eligible unvaccinated adolescents. ( <i>n</i> = 124)	Grounded in Community-Based Participatory Research (CBPR)	<ul style="list-style-type: none"> <li>Digital Storytelling (DST)</li> <li>Narrative as culture-centric health promotion</li> </ul>	<ul style="list-style-type: none"> <li>Intervention group</li> <li>DVD video health education</li> <li>Control group (none)</li> </ul>	<ul style="list-style-type: none"> <li>Intervention post test participant reports (only qualitative answers reported)</li> <li>Stories were enlightening</li> <li>Improved their knowledge about HPV and cervical cancer</li> <li>Increased intention to vaccinate daughters</li> <li>Daughters HPV vaccination intentions</li> <li>Increase in intention to be vaccinated (Intervention to control: 4–1)</li> <li>Vaccination initiation (any doses)</li> <li>No difference between intervention and control (2:2)</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling)</li> <li>Recall (self-reported vaccination)</li> <li>Response bias</li> </ul>
Chen et al. (2023), Kim et al. (2023)	Korean American ( <i>n</i> = 50) and Vietnamese American ( <i>n</i> = 114) female caregivers to mixed gendered vaccine – eligible unvaccinated adolescents.	Grounded in Community-Based Participatory Research (CBPR)	<ul style="list-style-type: none"> <li>Digital Storytelling (DST)</li> <li>Narrative as culture-centric health promotion</li> </ul>	<ul style="list-style-type: none"> <li>Intervention group</li> <li>DVD video health education</li> <li>Control group (none)</li> </ul>	<ul style="list-style-type: none"> <li>Changes pre and post-intervention surveys</li> <li>Composite attitude scale scores showed no significant difference (pretest <i>M</i> = 2.24; posttest <i>M</i> = 2.16), <i>t</i>(113) = 1.108, <i>P</i> = 0.270</li> <li>Improvement on one perceived risk question (pretest <i>M</i> = 2.32; posttest <i>M</i> = 2.07), <i>t</i>(113) = –2.11, <i>P</i> = 0.037</li> <li>Improvement on socio-cultural measure ((pretest <i>M</i> = 2.3; posttest <i>M</i> = 1.99), <i>t</i>(113) = –2.60, <i>P</i> = 0.011)</li> <li>One perception question had a change contrary to expectation ((pretest <i>M</i> = 2.39; posttest <i>M</i> = 2.75), <i>t</i>(113) = 2.49, <i>P</i> = 0.014).</li> <li>Narrative quality assessment scale</li> <li>Mean score for identification was 3.9 (SD = 1.0; range, 1–5),</li> <li>Mean score for engagement/transportation was 4.1 (SD = 1.0; range, 1–5).</li> <li>87% of participants (<i>n</i> = 99) reported they would recommend the digital stories to their relatives, friends, or colleagues</li> <li>HPV vaccination intentions</li> <li>Post intervention, 74% intended to vaccinate their children versus 53% pre – intervention (OR = 9.12; Cohen <i>g</i> = 0.40; <i>I</i>, <i>N</i> = 114) = 17.63, <i>P</i> &lt; 0.001; exact test <i>P</i> &lt; 0.001.</li> </ul>	<ul style="list-style-type: none"> <li>Selection (Convenience sampling)</li> </ul>

Valdez et al. (2015) Latino-American ( $n = 352$ ) and Korean-American ( $n = 313$ ) Not specified female and male caregivers to mixed gendered vaccine – eligible adolescents.

- Theory of Planned Behaviour (TPB)
  - Intervention group
    - Health education DVD videos in language.
  - Control group
    - Written vaccine information in language.

#### HPV vaccination intentions

- Post intervention, 79% intended to vaccinate their children versus 62.8% pre – intervention ( $N = 164$ ,  $\chi^2 = 18.38$ ,  $P < .001$ )

#### Changes pre and post-intervention surveys

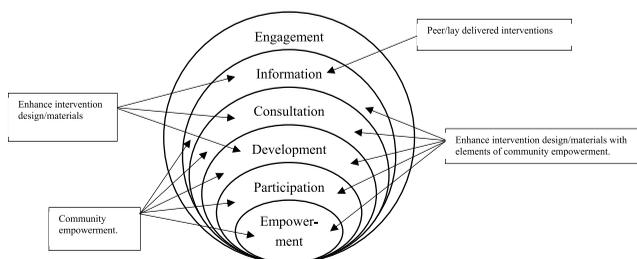
- Compared to controls the intervention group had:
  - 2.4 times the odds of informed decision regarding HPV vaccination
  - Significantly greater increases in their knowledge measures vs controls (1.7 points greater in the intervention group than in the control group ( $P < 0.0001$ ) after adjustments)
  - Decreases in decisional conflict (8 points greater in magnitude than that of control group members ( $P < 0.0001$ ) after adjustments)

- Selection (Convenience sampling),
- Recall (self-reported vaccination),
- Reporting bias.

Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022; McFadden et al. 2021; Shin et al. 2022; Valdez et al. 2015; Scarinci, Hansen, and Kim 2020; Shin et al. 2022; Valdez et al. 2015; Chen et al. 2023; Kim et al. 2023). All were published between 2011 and 2022 and all were conducted in the United States. Thirteen were implemented after the US Advisory Committee on Immunization Practices (ACIP) (CDCa (Centers for Disease Control and Prevention) 2011) approval for routine HPV vaccination for boys (Aragones et al. 2015; Berenson et al. 2019; Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Hirth et al. 2019, 2022; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022; McFadden et al. 2021; Shin et al. 2022) and seven before the ACIP (Meites and Markowitz 2016) recommendation of a 2-dose HPV vaccine schedule for 9–14 years old (Aragones et al. 2015; Kepka et al. 2011; Lee et al. 2018; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Valdez et al. 2015) (Figures 2–3).

Ten interventions were set in urban cities (Aragones et al. 2015; Berenson et al. 2019; Celentano et al. 2021; Chen, Kim, and Larkey 2019; Chen et al. 2022; Chen et al. 2023; Chu et al. 2021; Hirth et al. 2019; Hirth et al. 2022; Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022; McFadden et al. 2021; Shin et al. 2022; Kim et al. 2023) with the remainder in regional rural (Kepka et al. 2011, 2012), regional (Scarinci, Hansen, and Kim 2020) or USA-Mexico border communities (Molokwu et al. 2019; Parra-Medina et al. 2015). Intervention participants identified as Mexican American/Hispanic (Aragones et al. 2015; Berenson et al. 2019; Hirth et al. 2019; Hirth et al. 2022; Kepka et al. 2011, 2012; Molokwu et al. 2019; Parra-Medina et al. 2015); African American (Berenson et al. 2019; Hirth et al. 2019; Hirth et al. 2022; Lennon et al. 2019); East African migrants (Celentano et al. 2021; Chu et al. 2021; McFadden et al. 2021; Shin et al. 2022); Hispanic speaking Latinx (Scarinci, Hansen, and Kim 2020; Valdez et al. 2015); Korean Americans (Chen et al. 2023; Kim et al. 2023; Valdez et al. 2015); Vietnamese Americans (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Kim et al. 2023); Cambodian Americans (Lee et al. 2017, 2018); Chinese Americans (Ma et al. 2022); and Asian/other participants (Berenson et al. 2019; Hirth et al. 2019; Hirth et al. 2022).

Twenty-one studies self-described their CE practice (Table 3) (Aragones et al. 2015; Berenson et al. 2019; Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Hirth et al. 2019; Hirth et al. 2022; Kepka et al. 2011, 2012; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci,



**Figure 2.** Our assessment of HPV vaccination CE practices (Table 4) compared to O'Mara-Eves et al. (2013) proposed CE practice continuum.



et al. 2022; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020). Of seven measuring post intervention vaccination intentions, (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Kepka et al. 2011; Kim et al. 2023; Lee et al. 2018; Parra-Medina et al. 2015) five reported significant improvements (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Kim et al. 2023; Lee et al. 2018; Parra-Medina et al. 2015). Of five measuring post intervention initiation (Aragones et al. 2015; Celentano et al. 2021; Chu et al. 2021; Lee et al. 2018; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020) two reported significant improvement (Chu et al. 2021; Scarinci, Hansen, and Kim 2020). Two of these five studies reported participant intervention satisfaction, showing positive results (Celentano et al. 2021; Scarinci, Hansen, and Kim 2020).

### **3.2. CE practices across interventions**

Table 4 presents the CE elements as reported in each study. We present our synthesis below as guided by Table 2.

#### **3.2.1. How communities and their health needs are identified**

Across CE practices and studies participants were defined by racial/ethnicity demographics and geographical boundaries. All studies reported normative, expressed, and comparative community health needs (Table 4). Seven also reported health needs related to the social determinants of health (Kepka et al. 2011; Lee et al. 2018; Lennon et al. 2019; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020). Two using a community based participatory research (CBPR) approach reported the felt needs of partners (Lee et al. 2017, 2018; Lennon et al. 2019).

As outlined by O'Mara-Eves et al. (2013), this finding suggests that 12 interventions applied community outsider definitions and identifiers of health needs rather than reporting partners' community definitions or health needs (Aragones et al. 2015; Berenson et al. 2019; Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Hirth et al. 2019, 2022; Kepka et al. 2011, 2012; Kim et al. 2023; Ma et al. 2022; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Shin et al. 2022; Valdez et al. 2015). Due to the similar approach taken across studies, we could not link this framework element (Table 2) to measured outcomes.

#### **3.2.2. Motivations to practice CE and links to theories/models used**

Across studies, academics/researchers engaged with various community partners (Table 4). Thirteen reported partnerships with bicultural community health care workers (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Kepka et al. 2011, 2012; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020) and/or local CALD community members and leaders (Celentano et al. 2021; Chen et al. 2022; Chen, Kim, and Larkey 2019; Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022; McFadden et al. 2021; Shin et al. 2022). Five also partnered with local non-government organisations/services (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019;

**Table 4.** Community engagement framework elements (O'Mara-Eves et al. 2013) as reported by studies.

Community engagement (CE) Framework details provided in studies (O'Mara-Eves et al. 2013)								
Intervention name (citation)	Community Partners	Identification of communities and their health needs	Motivations to practice CE	Partner participation in CE intervention	Conditions, context or mediators supporting the CE environment	Processes of CE	Impact of CE	Potential O'Mara-Eves CE categori-sation (defined in Table 1)
Health Window Program (Aragones et al. 2015)	<ul style="list-style-type: none"> <li>Mexican consulate</li> <li>Other government institutions (not specified)</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative,</li> <li>Expressed.</li> </ul>	<p><i>Partners</i></p> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <p><i>Authors</i></p> <ul style="list-style-type: none"> <li>Use the Health Window programme to assess effectiveness of intervention.</li> </ul>	<ul style="list-style-type: none"> <li>Provided access to participants</li> <li>Delivered health education.</li> </ul>	<ul style="list-style-type: none"> <li>Health Window programmes are a community health programme running in 50+ Mexican consulates;</li> <li>Crediting partners with intervention successes</li> <li>Grant or institution funding.</li> </ul>	Not reported.	<p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>One manuscript author from Consulate.</li> </ul> <p><i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participated in the intervention</li> </ul>	CE for peer or lay delivered interventions.
Patient Navigators at health clinic (Berenson et al. 2019; Hirth et al. 2019; Hirth et al. 2022)	<ul style="list-style-type: none"> <li>Two paediatric clinics;</li> <li>One adolescent gynaecology clinic.</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative,</li> <li>Expressed.</li> </ul>	<p><i>Partners</i></p> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <p><i>Authors</i></p> <ul style="list-style-type: none"> <li>Not reported.</li> </ul>	<ul style="list-style-type: none"> <li>Provided intervention site;</li> <li>Administered vaccination;</li> <li>Answered participant questions;</li> <li>Recommended vaccination</li> <li>Participated in evaluation.</li> </ul>	<ul style="list-style-type: none"> <li>Financial compensation for patient navigators;</li> <li>Grant or institution funding.</li> </ul>	<ul style="list-style-type: none"> <li>Partners received education training.</li> </ul>	<p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>Patient navigators acknowledged in manuscript.</li> </ul> <p><i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participate in the intervention</li> </ul>	CE for peer or lay delivered interventions
Promotora Outreach (Molokwu et al. 2019)	<ul style="list-style-type: none"> <li>Bilingual community health workers (Promotoras).</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> </ul>	<p><i>Partners</i></p> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <p><i>Authors</i></p> <ul style="list-style-type: none"> <li>Expand on previous multicomponent interventions to increase vaccination completion rates.</li> <li>Use Promotoras to address cultural and language barriers.</li> </ul>	<ul style="list-style-type: none"> <li>Recruited participants;</li> <li>Delivered intervention;</li> <li>Collected data</li> </ul>	<ul style="list-style-type: none"> <li>Grant or institution funding;</li> <li>Partners credited with intervention success;</li> <li>Historical partnership.</li> </ul>	<ul style="list-style-type: none"> <li>Partners trained to deliver health education.</li> <li>Promotora-led intervention (p.118).</li> </ul>	<p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>Not reported</li> </ul> <p><i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participate in the intervention</li> </ul>	CE for peer or lay delivered interventions

(Continued)



Table 4. Continued.

Community engagement (CE) Framework details provided in studies (O'Mara-Eves et al. 2013)								
Intervention name (citation)	Community Partners	Identification of communities and their health needs	Motivations to practice CE	Partner participation in CE intervention	Conditions, context or mediators supporting the CE environment	Processes of CE	Impact of CE	Potential O'Mara-Eves CE categorisation (defined in Table 1)
Promotora Outreach (Parra-Medina et al. 2015)	<ul style="list-style-type: none"> <li>University Researchers;</li> <li>University Colonias Programme;</li> <li>Community Resource Centres;</li> <li>Kappa Delta Chi Sorority.</li> </ul>	<i>Defined By</i> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity.</li> </ul> <i>Health Needs identified</i> <ul style="list-style-type: none"> <li>Normative;</li> <li>Comparative;</li> <li>Expressed.</li> </ul>	<i>Partners</i> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <i>Authors</i> <ul style="list-style-type: none"> <li>Promotora model has been successfully used before to address community health issues.</li> <li>Determine if promotora based education can improve vaccination uptake.</li> </ul>	<ul style="list-style-type: none"> <li>Recruited participants</li> <li>Delivered intervention;</li> <li>Collected data;</li> <li>Promotora insights provided in manuscript.</li> </ul>	<ul style="list-style-type: none"> <li>One partner organisation has worked with local community for 20 years</li> <li>Promotoras were hired to deliver programme;</li> <li>Partners credited with intervention success;</li> <li>Grant or institution funding;</li> </ul>	<ul style="list-style-type: none"> <li>Partners received training.</li> </ul>	<i>Benefits to Partners</i> <ul style="list-style-type: none"> <li>Partners acknowledged in manuscript</li> </ul> <i>Community beneficiaries</i> <p>Individuals who participate in the intervention</p>	CE for peer or lay delivered interventions
Education Sessions (Scarinci, Hansen, and Kim 2020)	<ul style="list-style-type: none"> <li>Spanish speaking Lay Health Educators.</li> </ul>	<i>Defined By</i> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity.</li> </ul> <i>Health Needs identified</i> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> </ul>	<i>Partners</i> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <i>Authors</i> <ul style="list-style-type: none"> <li>Assess efficacy of intervention to promote vaccination uptake</li> </ul>	<ul style="list-style-type: none"> <li>Recruited participants;</li> <li>Delivered intervention;</li> <li>Collected participant data.</li> </ul>	<ul style="list-style-type: none"> <li>Partners trained;</li> <li>Partners credited with intervention success;</li> <li>Grant or institution funding.</li> </ul>	<ul style="list-style-type: none"> <li>Partners trained.</li> </ul>	<i>Benefits to Partners</i> <ul style="list-style-type: none"> <li>Not reported</li> </ul> <i>Community beneficiaries</i> <p>Individuals who participate in the intervention</p>	CE for peer or lay delivered interventions
Interactive Educational Forum (Chu et al. 2021) & Comic Book for adolescents (Celentano et al. 2021; Shin et al. 2022)	<ul style="list-style-type: none"> <li>Co-ethnic health professionals.</li> <li>Community partners and stakeholders (no further details reported)</li> <li>East African community members</li> </ul>	<i>Defined By</i> <ul style="list-style-type: none"> <li>Geography</li> <li>Ethnicity</li> </ul> <i>Health Needs identified</i> <ul style="list-style-type: none"> <li>Normative</li> <li>Comparative</li> <li>Expressed</li> </ul>	<i>Partners</i> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <i>Authors</i> <ul style="list-style-type: none"> <li>Intervention format is based on previous research findings.</li> <li>Both interventions are part of a multilevel</li> </ul>	<ul style="list-style-type: none"> <li>Delivered health education (Chu et al. 2021);</li> <li>Answered participant questions (Chu et al. 2021);</li> <li>Reviewed materials (Celentano et al. 2021; Chu et al. 2021; Shin et al. 2022)</li> </ul>	<ul style="list-style-type: none"> <li>Co-ethnic research team members (Celentano et al. 2021; Chu et al. 2021; Shin et al. 2022);</li> <li>Participants, co-ethnic health professionals, and research assistants</li> </ul>	<ul style="list-style-type: none"> <li>Commented on cultural appropriateness of survey items (Chu et al. 2021)</li> <li>Consultation with partners at multiple stages (no further details) (Celentano</li> </ul>	<i>Benefits to Partners</i> <ul style="list-style-type: none"> <li>One author affiliation from Somali Health Board</li> <li>One author affiliation from Cancer Research Centre</li> </ul>	CE for patient/ consumer involvement and to enhance services

			communication intervention.	<ul style="list-style-type: none"> <li>Recruitment assistance (Chu et al. 2021).</li> </ul>	<ul style="list-style-type: none"> <li>acknowledged in manuscript (Chu et al. 2021)</li> <li>Grant or institution funding (Chu et al. 2021)</li> </ul>	et al. 2021; Shin et al. 2022);	<i>Community beneficiaries</i> <ul style="list-style-type: none"> <li>Individuals who participate in the intervention</li> </ul>	
Radionovela (Kepka et al. 2011, 2012)	<ul style="list-style-type: none"> <li>Local radio station;</li> <li>Local Spanish speaking health educators (no further details).</li> </ul>	<i>Defined By</i> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <i>Health Needs identified</i> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> </ul>	<i>Partners</i> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <i>Authors</i> <ul style="list-style-type: none"> <li>Similar partnerships have resulted in effective messages.</li> </ul>	<ul style="list-style-type: none"> <li>Radionovella produced in collaboration with partners.</li> </ul>	<ul style="list-style-type: none"> <li>Grant or institution funding.</li> </ul>	Not reported.	<i>Benefits to Partners</i> <ul style="list-style-type: none"> <li>Partners acknowledged in manuscript.</li> </ul> <i>Community beneficiaries</i> <ul style="list-style-type: none"> <li>Individuals who participated in the intervention</li> </ul>	CE for patient/consumer involvement and to enhance services
Continuing Education Course for Healthcare providers (McFadden et al. 2021)	<ul style="list-style-type: none"> <li>Local public Health units;</li> <li>WithinReach organisation;</li> <li>East African community members.</li> </ul>	<i>Defined By</i> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <i>Health Needs identified</i> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> </ul>	<i>Partners</i> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <i>Authors</i> <ul style="list-style-type: none"> <li>Similar partnerships have resulted in effective messages.</li> </ul>	<ul style="list-style-type: none"> <li>Reviewed materials;</li> <li>Recruitment of participants</li> </ul>	<ul style="list-style-type: none"> <li>Co-ethnic research team members;</li> <li>Grant or institution funding;</li> </ul>	<ul style="list-style-type: none"> <li>Review of course content to ensure cultural appropriateness and relevancy</li> </ul>	<i>Benefits to Partners</i> <ul style="list-style-type: none"> <li>One author affiliation from Somali Health Board;</li> <li>One author affiliation from Cancer Research Center;</li> <li>One author affiliation from Public Health Unit.</li> </ul> <i>Community beneficiaries</i> <ul style="list-style-type: none"> <li>Individuals who participated in the intervention</li> </ul>	CE for patient/consumer involvement and to enhance services
Tailored Video Education Session (Valdez et al. 2015)	<ul style="list-style-type: none"> <li>Mexican American Community Services Agency;</li> <li>Korean Health Education;</li> <li>Information and Research Centre;</li> <li>Additional academic partners.</li> </ul>	<i>Defined By</i> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <i>Health Needs identified</i> <ul style="list-style-type: none"> <li>Normative;</li> <li>Comparative;</li> <li>Expressed.</li> </ul>	<i>Partners</i> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <i>Authors</i> <ul style="list-style-type: none"> <li>Develop a culturally appropriate, parent-cantered intervention to at risk communities.</li> </ul>	<ul style="list-style-type: none"> <li>Partners collaborated in formative research phase (no further details provided);</li> <li>Some partners provided cultural insights and language guidance for DVD production.</li> </ul>	<ul style="list-style-type: none"> <li>Bicultural research assistants;</li> <li>Grant or institution funding.</li> </ul>	<ul style="list-style-type: none"> <li>Some partners provided cultural insights on findings.</li> </ul>	<i>Benefits to Partners</i> <ul style="list-style-type: none"> <li>One manuscript author from Health Point Communications Institute;</li> <li>One manuscript author from County Health Department;</li> </ul>	CE for patient/consumer involvement and to enhance services

(Continued)

**Table 4.** Continued.

Community engagement (CE) Framework details provided in studies (O'Mara-Eves et al. 2013)								
Intervention name (citation)	Community Partners	Identification of communities and their health needs	Motivations to practice CE	Partner participation in CE intervention	Conditions, context or mediators supporting the CE environment	Processes of CE	Impact of CE	Potential O'Mara-Eves CE categorisation (defined in Table 1)
Multi-modal Intervention (Ma et al. 2022)	<ul style="list-style-type: none"> <li>Local parents;</li> <li>Healthcare providers (specific details not reported);</li> <li>Adolescents;</li> <li>Community Leaders (specific details not reported).</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> </ul>	<p><i>Partners</i></p> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <p><i>Authors</i></p> <ul style="list-style-type: none"> <li>Evaluate effectiveness of intervention.</li> </ul>	<ul style="list-style-type: none"> <li>Partners engaged in planning, development, and implementation process.</li> </ul>	<ul style="list-style-type: none"> <li>Grant or institution funding.</li> </ul>	<ul style="list-style-type: none"> <li>Guided by CBPR;</li> <li>Collaborated with a community health centre to ensure intervention was age and culturally appropriate.</li> </ul>	<ul style="list-style-type: none"> <li>Other partners acknowledged in manuscript.</li> </ul> <p><i>Community beneficiaries</i></p> <p>Individuals who participated in the intervention</p> <p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>Two manuscript authors from Greater Philadelphia Health Action Inc;</li> <li>Clinical collaborator and their staff acknowledged in manuscript</li> </ul> <p><i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participate in the intervention</li> </ul>	<p>CE for patient/consumer involvement and to enhance services</p> <p>And/or CE to reduce health inequities</p>
Digital Story-telling (Chen, Kim, and Larkey 2019, 2022)	<ul style="list-style-type: none"> <li>Local community members</li> <li>Asian Pacific Community in Action</li> <li>Media producer.</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> </ul>	<p><i>Partners</i></p> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <p><i>Authors</i></p> <ul style="list-style-type: none"> <li>Similar partnerships resulted in effective messages;</li> <li>Wanted recruitment support.</li> </ul>	<ul style="list-style-type: none"> <li>Co-developed stories;</li> <li>Participant recruitment</li> </ul>	<ul style="list-style-type: none"> <li>Multicultural research team</li> <li>Bilingual research assistants</li> <li>Grant or institution funding;</li> </ul>	<ul style="list-style-type: none"> <li>Guided by CBPR;</li> <li>Partners trained;</li> <li>Co-creation of digital stories.</li> </ul>	<p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>Acknowledged study participants and partners in manuscript;</li> </ul> <p><i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participated in the intervention</li> </ul>	<p>CE for patient/consumer involvement and to enhance services</p> <p>And/or CE to reduce health inequities</p>
Digital Story-telling (Chen et al. 2023; Kim et al. 2023)	<ul style="list-style-type: none"> <li>Local community members</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul>	<p><i>Partners</i></p> <ul style="list-style-type: none"> <li>Not reported.</li> </ul> <p><i>Authors</i></p>	<ul style="list-style-type: none"> <li>Co-developed stories;</li> <li>Participant recruitment</li> </ul>	<ul style="list-style-type: none"> <li>Multicultural research team</li> </ul>	<ul style="list-style-type: none"> <li>Guided by CBPR;</li> <li>Partners trained;</li> </ul>	<p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>Acknowledged study participants</li> </ul>	<p>CE for patient/consumer involvement and to</p>

	<ul style="list-style-type: none"> <li>Asian Pacific Community in Action</li> <li>The Arizona Partnership for Immunisation</li> <li>Media producer.</li> </ul>	<p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> </ul>	<ul style="list-style-type: none"> <li>Similar partnerships resulted in effective messages;</li> <li>Wanted recruitment support.</li> </ul>	<ul style="list-style-type: none"> <li>Bilingual research assistants</li> <li>Grant or institution funding;</li> </ul>	<ul style="list-style-type: none"> <li>Co-creation of digital stories.</li> </ul>	<p>and partners in manuscript; <i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participated in the intervention</li> </ul>	<p>enhance services And/or CE to reduce health inequities</p>	
Multi-modal Intervention (Lennon et al. 2019)	<ul style="list-style-type: none"> <li>Community Leaders/Agency Representatives (not specific);</li> <li>Health educators (not specific);</li> <li>Public health officials;</li> <li>Health care professionals;</li> <li>Community residents;</li> <li>Marquette University faculty;</li> <li>Local immunisation Coalitions</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> <li>Felt</li> </ul>	<p><i>Partners &amp; Authors</i></p> <ul style="list-style-type: none"> <li>Thought CBPR approach would address immunisation disparities in children 19–35 months old;</li> <li>Wanted to see if there was ancillary effect in HPV immunisation for older siblings.</li> </ul>	<ul style="list-style-type: none"> <li>A steering team, executive committee, and community forward team (CFT) provided oversight for all elements of implementation</li> <li>Recruitment of participants;</li> <li>Intervention delivery.</li> <li>Collected participant data;</li> <li>Lead collaborative organisations to disseminate intervention tools and results.</li> </ul>	<ul style="list-style-type: none"> <li>Historical partnership;</li> <li>Grant or institution funding.</li> </ul>	<ul style="list-style-type: none"> <li>Guided by CBPR;</li> <li>Partners trained</li> <li>Partnership decision-making details;</li> <li>Multiple committees and roles for researchers and partners;</li> <li>Communication with partners through meetings;</li> <li>Communication with wider community through social media.</li> </ul>	<p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>One manuscript author from Global Health News Wire</li> <li>One manuscript author a Community Forward Team member</li> </ul> <p><i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participate in the intervention</li> </ul>	<p>CE to reduce health inequities</p>
Narrative (video) Story-telling (Lee et al. 2017; Lee et al. 2018)	<ul style="list-style-type: none"> <li>Community leaders</li> <li>Community researchers;</li> <li>Community health centre Representatives;</li> <li>Community youth organisations</li> <li>Local college student associations.</li> </ul>	<p><i>Defined By</i></p> <ul style="list-style-type: none"> <li>Geography;</li> <li>Ethnicity</li> </ul> <p><i>Health Needs identified</i></p> <ul style="list-style-type: none"> <li>Normative,</li> <li>Comparative</li> <li>Expressed</li> <li>Felt</li> </ul>	<p><i>Partners &amp; Authors</i></p> <ul style="list-style-type: none"> <li>Similar interventions have worked in similar communities;</li> <li>Partnership agreed</li> <li>story-telling was the best approach;</li> <li>Leveraged historic partnerships to support participant recruitment.</li> </ul>	<ul style="list-style-type: none"> <li>Collaborative approach to Intervention design and development;</li> <li>Participant recruitment;</li> <li>Intervention delivery;</li> <li>Data collection;</li> <li>Intervention evaluation.</li> </ul>	<ul style="list-style-type: none"> <li>Filed notes incorporated in final manuscript;</li> <li>Historical partnership;</li> <li>Bilingual data collectors;</li> <li>Grant/institutional funding.</li> </ul>	<ul style="list-style-type: none"> <li>Guided by CBPR</li> <li>Some partners trained and paid to recruit from their networks.</li> <li>Some partnership decision making details provided.</li> </ul>	<p><i>Benefits to Partners</i></p> <ul style="list-style-type: none"> <li>One author affiliation as Community Outreach Liaison.</li> <li>Some listed in manuscript acknowledgment section.</li> </ul> <p><i>Community beneficiaries</i></p> <ul style="list-style-type: none"> <li>Individuals who participate in the intervention</li> </ul>	<p>CE to reduce health inequities</p>

Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; McFadden et al. 2021; Valdez et al. 2015).

When comparing studies to framework element two (Table 2) (O'Mara-Eves et al. 2013), 11 reported the study and partnership motivations based on authors' perspectives and did not report partner perspectives (Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Kepka et al. 2011, 2012; Kim et al. 2023; Lee et al. 2017; Lee et al. 2018; Lennon et al. 2019; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Shin et al. 2022). This contrasts with two CBPR interventions reporting joint researcher and partner motivations for the project and partnership (Lee et al. 2017, 2018; Lennon et al. 2019) (Table 4). Though in the latter two studies neither reported who initiated the original partnership.

Due to the missing information about partners' motivations for being involved (Table 4), we could not link this framework element to intervention outcomes.

### **3.2.3. Partner participation in CE**

Partner participation in CE (Table 2) varied across all interventions (Table 4). Twelve reported how partners recruited intervention participants (Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Shin et al. 2022), provided the setting for participant recruitment (Aragones et al. 2015; Berenson et al. 2019; Chen et al. 2023; Hirth et al. 2019; Hirth et al. 2022; Kim et al. 2023), delivered interventions directly to intervention participants (Aragones et al. 2015; Berenson et al. 2019; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020) or reviewed intervention materials for cultural appropriateness (Celentano et al. 2021; Chu et al. 2021; McFadden et al. 2021; Shin et al. 2022). Some partners also administered vaccines (Berenson et al. 2019; Hirth et al. 2019; Hirth et al. 2022), produced (Kepka et al. 2011, 2012) or co-developed intervention materials (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Kim et al. 2023) or provided cultural insights on findings (Parra-Medina et al. 2015; Valdez et al. 2015). When we link these findings to findings in sections 3.2.1 and 3.2.2, these variable levels of participation appear consistent with more health system driven CE (Table 1). This contrasts with three CBPR interventions that report partner engagement across all intervention development and design phases (Table 4) (Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022). This latter approach is consistent with more community empowerment CE practices (Table 1).

Regardless of the CE practiced or partner involvement (Table 4) all studies measured post-intervention improvements (Table 3). So we could not link a specific CE practice or approach to better intervention outcome measures.

### **3.2.4. Conditions, context or mediators supporting CE environments**

All authors reported limited details about the conditions, context and mediators supporting their CE environment (Table 2). Due to this we could only make broad level assessments of the CE conditions or contexts rather than link if the CE environment fully supported partner participation in CE or if the CE conditions were positive, sustainable, or maximised (O'Mara-Eves et al. 2013).

For example, in 10 studies (Aragones et al. 2015; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Valdez et al. 2015) we inferred positive partnership attitudes when authors formally credited intervention successes to their partners (Aragones et al. 2015; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020) or reported where partner insights were included in the manuscript (Lee et al. 2017, 2018; Parra-Medina et al. 2015; Valdez et al. 2015). No study reported, though, on the attitudes of community partners towards researchers.

Of these 10 (all of which practised different types of CE) four measured improvements in post intervention vaccination series completion (Lennon et al. 2019; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020) or vaccination knowledge and intention to vaccinate (Chu et al. 2021; Lee et al. 2018; Parra-Medina et al. 2015; Valdez et al. 2015). Five (Chen et al. 2022; Chen et al. 2023; Chu et al. 2021; Lee et al. 2018; Parra-Medina et al. 2015) of seven only measuring post vaccination intention also reported improvements (Chen et al. 2022; Chen et al. 2023; Chu et al. 2021; Lee et al. 2018; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Valdez et al. 2015) and two (Chu et al. 2021; Scarinci, Hansen, and Kim 2020) of six reporting post-intervention initiation also reported significant improvements (Aragones et al. 2015; Chu et al. 2021; Lee et al. 2018; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020).

We also noted when bi-cultural researchers (Aragones et al. 2015; Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Shin et al. 2022; Valdez et al. 2015), data collectors (Aragones et al. 2015; Lee et al. 2017, 2018; Lennon et al. 2019; Parra-Medina et al. 2015) and bi-cultural organisations (Aragones et al. 2015; Parra-Medina et al. 2015) were embedded into the research team or setting. Of these, all six measuring post intervention vaccination knowledge recorded increases (Chen et al. 2022; Chen, Kim, and Larkey 2019; Chu et al. 2021; Lee et al. 2017, 2018; McFadden et al. 2021; Parra-Medina et al. 2015; Shin et al. 2022; Valdez et al. 2015) and three (Aragones et al. 2015; Lennon et al. 2019; Parra-Medina et al. 2015) of five measured increases in post intervention uptake or series completion (Aragones et al. 2015; Chu et al. 2021; Lee et al. 2018; Lennon et al. 2019; Parra-Medina et al. 2015; Shin et al. 2022).

### **3.2.5. CE Processes**

Overall studies reported limited details about their CE processes (Table 4). Key details missed included reporting on research/academic team members participating in co-learning or cultural training and any conducted cost-analysis or partnership process evaluations. This lack of detail limited our ability to link supportive (or not) CE processes and intervention outcomes (O'Mara-Eves et al. 2013).

Of CE process details reported, seven interventions reported training partners to implement interventions (Berenson et al. 2019; Chen et al. 2022; Chen, Kim, and Larkey 2019; Hirth et al. 2019; Hirth et al. 2022; Lee et al. 2017, 2018; Lennon et al. 2019; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020)

with five of five measuring increased post intervention series completion (Berenson et al. 2019; Lennon et al. 2019; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020), three of three reporting increased vaccination knowledge (Chen et al. 2022; Chen, Kim, and Larkey 2019; Lee et al. 2018; Parra-Medina et al. 2015) and two (Berenson et al. 2019; Scarinci, Hansen, and Kim 2020) of five reporting increased initiation (Berenson et al. 2019; Lee et al. 2018; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020).

Four CBPR studies reported information about how involved partners were in project decision-making (Chen et al. 2022; Chen, Kim, and Larkey 2019; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019). Of these, one reported increased in post intervention vaccine knowledge (Lee et al. 2017, 2018) and one (Lennon et al. 2019) in post intervention vaccine uptake/completion (Table 3).

### **3.2.6. The impact of CE**

According to O'Mara-Eves et al. health framework (Table 2) the impact of CE can be direct (specific to partners) or indirect (intervention participants and the wider community) (O'Mara-Eves et al. 2013).

We inferred that 10 studies directly CE impacted the professional development of partners by formally acknowledging (Berenson et al. 2019; Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Hirth et al. 2019, 2022; Kepka et al. 2011, 2012; Kim et al. 2023; Ma et al. 2022; Parra-Medina et al. 2015) or listing them as a manuscript author (Berenson et al. 2019; Celentano et al. 2021; Chu et al. 2021; Hirth et al. 2019; Hirth et al. 2022; Ma et al. 2022; McFadden et al. 2021; Shin et al. 2022; Valdez et al. 2015). Of these 10, all five measuring post-intervention vaccine knowledge reported increases (Ma et al. 2022; McFadden et al. 2021; Parra-Medina et al. 2015; Shin et al. 2022; Valdez et al. 2015) and three (Berenson et al. 2019; Ma et al. 2022; Parra-Medina et al. 2015) of four measuring vaccine initiation reported increases (Berenson et al. 2019; Chu et al. 2021; Ma et al. 2022; Parra-Medina et al. 2015; Shin et al. 2022).

When assessing studies for the indirect impact of CE (e.g. impact on study participants and the wider community), the we only found details related to post-intervention health outcomes of participants (summarised in Section 3.1 and Table 3). This finding is also consistent with more health service driven CE. No study reported on wider community implications of the CE intervention nor any partner or participant dissatisfaction or negative intervention impacts.

### **3.3. Summary of CE approaches and outcomes**

As outlined in Table 1, O'Mara-Eves et al. (2013) categorise CE practice as health service (CE conducted to enhance health services or peer/layperson delivered interventions) or community empowerment driven (CE to reduce health inequities). Based on the details reported, we classified nine interventions as being consistent with more health system driven CE (Aragones et al. 2015; Berenson et al. 2019; Celentano et al. 2021; Chu et al. 2021; Hirth et al. 2019; Hirth et al. 2022; Kepka et al. 2011, 2012; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Shin et al. 2022; Valdez et al. 2015). Of five interventions guided by community

empowerment and social justice philosophies (e.g. CBPR) (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; Ma et al. 2022), two interventions show evidence of more community driven CE (Lee et al. 2017, 2018; Lennon et al. 2019) and three report CE elements consistent with both health system and community driven CE (Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Kim et al. 2023; Ma et al. 2022).

#### 4. Discussion

Our review describes how CE is practised in HPV vaccination interventions targeting CALD communities in the setting of the USA. These findings reaffirm that CE is a spectrum of practices (Cyril et al. 2015; O'Mara-Eves et al. 2013; Wallerstein 2021). However, due to missing CE practice details, we experienced difficulty comparing CE practices across interventions. Despite this, using O'Mara-Eves et al.'s CE framework we demonstrated that many HPV vaccination CE interventions targeting CALD communities appear health system driven (O'Mara-Eves et al. 2013). Consistent with O'Mara-Eves et al.'s (2013) findings, we also found that health service driven CE is linked to better intervention outcomes, especially with interventions applying multi-components or elements to improve vaccination (Aragones et al. 2015; Berenson et al. 2019; Lennon et al. 2019; Ma et al. 2022; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020). Interestingly, only three of these successful interventions reported significant increases in vaccination initiation (Berenson et al. 2019; Ma et al. 2022; Scarinci, Hansen, and Kim 2020). This is important to note because CE practitioners may need to adapt or change their approaches when designing interventions in a single-dose HPV vaccination schedule (World Health Organization 2022).

We also note how our findings contrast with other CE reviews showing that more community partner empowerment and health equity focused interventions have better intervention outcomes (Brunton et al. 2017; Cyril et al. 2015). We believe this finding outlines a common tension for those practising CE in underserved communities, where the need to show improved health outcomes is balanced with the intention to promote community empowerment to health equity. Below we offer some explanations as to why the immunisation context may be different to other public health intervention settings.

First, vaccination acceptance is a complex health behaviour (TIP (Tailoring Immunization Programmes) 2019). In CALD communities where vaccination motivations are high, a health system-driven CE intervention may be very appropriate and successful to improve uptake (Aragones et al. 2015; Berenson et al. 2019; Kepka et al. 2011; Ma et al. 2022; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020). For other communities that have experienced discrimination and long-standing systematic barriers, a community-led or community-driven approach (Cunningham-Erves et al. 2021; Lennon et al. 2019) – supporting more equitable partner involvement and power sharing – will be more successful, sustainable and culturally appropriate (Wallerstein et al. 2018).

Second, though ours and O'Mara-Eves et al.'s review shows that peer-led/delivered CE interventions improve individual participant health outcomes these interventions are known to be confounded compared to community driven CE (O'Mara-Eves et al.

2013). For example, the health system driven, peer-led/delivered CE interventions also had multiple components. As multicomponent vaccination interventions are proven to improve uptake – with or without CE – (Crocker-Buque et al. 2017; Crocker-Buque, Edelstein, and Mounier-Jack 2017) a single component peer-led/delivered CE intervention may not experience the same success. Additionally, all the successful peer-delivered interventions in our review involved a Spanish speaking population where, historically, peer-led/delivered health programmes are very well established and recognised and based on community-led programmes (Elder et al. 2009). A similar, community-led approach may be needed to appropriately adapt the peer-led/delivered CE approach to other CALD communities.

Last, all our included studies demonstrated a common practice of partnering with bi-cultural individuals either on the research team (Aragones et al. 2015; Celentano et al. 2021; Chen et al. 2022; Chen et al. 2023; Chen, Kim, and Larkey 2019; Chu et al. 2021; Kim et al. 2023; Lee et al. 2017, 2018; Lennon et al. 2019; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Shin et al. 2022; Valdez et al. 2015) or as community consultants (Aragones et al. 2015; Berenson et al. 2019; Celentano et al. 2021; Chu et al. 2021; Hirth et al. 2019; Hirth et al. 2022; Kepka et al. 2011, 2012; McFadden et al. 2021; Molokwu et al. 2019; Parra-Medina et al. 2015; Scarinci, Hansen, and Kim 2020; Shin et al. 2022; Valdez et al. 2015). Due to limited reporting details around CE partnerships, we know little about partners' satisfaction with the CE practice or applied interventions. Improving this reporting from partnership perspectives will support others wanting to maximise partnership resources and intervention outcomes (Cyril et al. 2015; O'Mara-Eves et al. 2013; Wallerstein 2021).

#### **4.1. Limitations and recommendations for future research**

In addition to the above, all our included studies have a risk of bias and are not generalisable outside of the USA. Many studies also lacked CE with CALD adolescent males and fathers and including this demographic may have changed intervention outcomes. Also, for a variety of reasons, such as journal word limits, many studies lacked CE practice details (Cyril et al. 2015; O'Mara-Eves et al. 2013; Wallerstein 2021), including the use of Community Advisory Boards. So our interpretations may not accurately reflect what CE was practised (Jain et al. 2022).

Our review process is also limited. This includes not registering our protocol and only one author independently screening and reviewing the list of studies. Relevant studies may have also been overlooked or missed because we excluded: grey literature, reports, foreign language studies, Indigenous populations, studies not using CE terminology in their titles and abstracts, studies not identifying their participants as CALD or dis-aggregate data according to CALD status.

## **5. Conclusion**

To meet the high HPV vaccination targets (90%) set by the WHO countries are encouraged to use CE practice to engage with underserved communities (World Health Organization 2020). By recognising how CE is practised, we highlight opportunities for the health system to better report CE practice (Wallerstein 2021). This review also supports

health systems and services to reflect on how they conduct their CE and partner engagements to decide what CE approach is most culturally appropriate or needed by the target community.

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## Author contributions

Conceptualisation – all authors; Data curation – KP; Preliminary analysis – KP; Data analysis review and insights – ABM, LP; Methodology – all authors; Project administration – KP; Supervision – ABM, LP; Visualisation – KP; Roles/Writing – original draft – KP; and Writing – review & editing – all authors.

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## Data availability statement

The data underlying the overall project described in this article are available in the article, its online supplementary material and from the corresponding author upon reasonable request.

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