unicef
for every child

EVIDENCE FOR ACTION

What Works to Increase Uptake of Childhood Immunization:

A RAPID EVIDENCE ASSESSMENT OF THE IMPACT OF INTERVENTIONS TARGETING CAREGIVERS, HEALTHCARE WORKERS AND COMMUNITIES

ACKNOWLEDGEMENTS

This report is a collaboration between UNICEF Innocenti and UNICEF Regional Office for Europe and Central Asia (ECARO). The review authors would like to thank Professor Julie Leask at the University of Sydney, Australia, for her role as an independent advisor at every step of the design and write-up of this study. The authors would also like to thank a reference group of national immunization professionals and representatives from UNICEF country offices in Europe and Central Asia for providing input and discussion on the results of this rapid evidence assessment (REA). The final report benefited from the review and input of UNICEF's global health and immunization teams, namely Dr Ephrem Tekle Lemango, Charles Nelson Kakaire and Deepa Risal Pokharel. The authors would also like to thank the Health Innovation team at UNICEF's Office of Innovation for their ongoing support to catalyze the validation and scaling of innovation solutions for Programmes.

UNICEF INNOCENTI – GLOBAL OFFICE OF RESEARCH AND FORESIGHT

UNICEF Innocenti – Global Office of Research and Foresight tackles the questions of greatest importance for children, both current and emerging. It drives change through research and foresight on a wide range of child rights issues, sparking global discourse and actively engaging young people in its work.

UNICEF Innocenti equips thought leaders and decision-makers with the evidence they need to build a better, safer world for children. The office undertakes research on unresolved and emerging issues, using primary and secondary data that represents the voices of children and families themselves. It uses foresight to set the agenda for children, including horizon scanning, trends analysis and scenario development. The office produces a diverse and dynamic library of high-level reports, analyses and policy papers, and provides a platform for debate and advocacy on a wide range of child rights issues.

UNICEF Innocenti provides, for every child, answers to their most pressing concerns.

UNICEF EUROPE AND CENTRAL ASIA

UNICEF works with and for disadvantaged children and adolescents across 22 countries and territories in Europe and Central Asia where we have country programmes. We also have programmes to respond to the needs of refugee and migrant women and children in the Czech Republic, Greece, Hungary, Italy, Poland and Slovakia, as well as engagement with institutions across many more countries to uphold the rights of children. In line with our mandate, shaped by the Convention on the Rights of the Child (CRC) and the Sustainable Development Goals (SDGs), we work to ensure that no child is left out of economic and social progress.

What works to increase uptake of childhood immunization: A rapid evidence assessment of the impact of interventions targeting caregivers, healthcare workers and communities - Study report

John O'Rourke,[1] Andrea Yearwood,[1] Greg Sheaf,[1] Sergiu Tomsa,[2] Viviane Bianco,[2] Mario Mosquera,[2] Shivit Bakrania[3] and Benjamin Hickler[3]

UNICEF Innocenti – Global Office of Research and Foresight, and UNICEF Regional Office for Europe and Central Asia (ECARO)
April 2023

SUGGESTED CITATION

O'Rourke, J., Yearwood, A., Sheaf, G., Tomsa, S., Bianco, V., Mosquera, M., Bakrania, S. and Hickler, B., *What Works to Increase Uptake of Childhood Immunization: A rapid evidence assessment of the impact of interventions targeting caregivers, healthcare workers and communities,* UNICEF Innocenti – Global Office of Research and Foresight, Florence, and UNICEF Regional Office for Europe and Central Asia (ECARO), 2023.

Design and layout: Big Yellow Taxi Inc.

Editorial production: Sarah Marchant, UNICEF Innocenti

Cover photo: © UNICEF/U.S. CDC/UN0705561/Kasia Strek
On 18 August 2022 in Kraków, Poland, 6-year-old Mykyta receives his immunizations from Nurse Ewelina Tytula at the UNIMED medical center. He left the Kyiv region of Ukraine on 2 March 2022 with his family, escaping the ongoing conflict. Mykyta is protected against measles, mumps, and rubella with the MMRvaX Pro vaccine; diphtheria, tetanus, and polio types 1, 2 and 3 with the Tetraxim vaccine; and chickenpox using the Varilrix vaccine.

1 Consultant to UNICEF Innocenti – Global Office of Research and Foresight
2 UNICEF Regional Office in Europe and Central Asia
3 UNICEF Innocenti – Global Office of Research and Foresight

EVIDENCE FOR ACTION

What Works to Increase Uptake of Childhood Immunization:

A RAPID EVIDENCE ASSESSMENT OF THE IMPACT OF INTERVENTIONS TARGETING CAREGIVERS, HEALTHCARE WORKERS AND COMMUNITIES

CONTENTS

ABBREVIATIONS

Abbreviation	Definition
3ie	International Initiative for Impact Evaluation
BCG	anti-tuberculosis vaccine (bacille Calmette-Guérin)
CI	confidence interval
COM-B	capability, opportunity, motivation and behaviour
CPSTF	Community Preventive Services Task Force
DF	direct financing
DFF	direct facility financing
DT	diphtheria, tetanus vaccine
DTP	diphtheria, tetanus and pertussis vaccine
ECARO	Europe and Central Asia Regional Office
EGM	evidence gap map
FFS	fee-for-service
GRADE	Grading of Recommendations, Assessment, Development and Evaluations
HCW	healthcare worker
HepB	hepatitis B vaccine
HEW	health extension worker
Hib	Haemophilus influenzae type b
HIC	high-income country
HPV	human papillomavirus
IPV	inactivated poliovirus vaccine
L&MIC	low- and middle-income countries
JOR	John O'Rourke
MCV	measles-containing vaccine

Abbreviation	Definition
MMR	measles, mumps and rubella vaccine
MMRV	measles, mumps, rubella and varicella vaccine
MR	measles and rubella vaccine
NGO	non-governmental organization
OPV	oral poliomyelitis vaccine
P4P	pay-for-performance
PBF	performance-based financing
PCV	pneumococcal conjugate vaccine
Pol3	third dose against polio
RBF	results-based financing
RCT	randomized controlled trial
REA	rapid evidence assessment
SES	socio-economic status
SSE	Social Systems Evidence
TBGI	Team-Based Goals and Incentives
TT	tetanus toxoid vaccine
UNICEF	United Nations Children's Fund
UK	United Kingdom
USA	United States of America
UTD	up-to-date vaccination
VZV	varicella-zoster virus
WHO	World Health Organization

On 24 June 2022, a Female Community Health Volunteer (right) interacts with Nitu Nepali and one-year-old Nitika at their home in the Jorayal Rural Municipality, Doti District, Nepal.

EXECUTIVE SUMMARY

BACKGROUND

Vaccination is one of the most effective measures for preventing illness, disability and death among children. However, current vaccination coverage provides insufficient protection for all children, and deaths from vaccine-preventable diseases account for an estimated 21.7 per cent of deaths in children under 5 years old globally.

This rapid evidence assessment (REA) looked at the global evidence regarding the effectiveness of interventions to increase uptake of vaccination services. The findings have global relevance but were also used to make more specific recommendations to address challenges identified in consultations with UNICEF's Europe and Central Asia Regional Office (ECARO). In Europe and Central Asia, national statistics indicate that vaccination rates are high; however, the rates between countries and over time vary greatly. In addition, some vulnerable and marginalized communities in the region have lower vaccination rates than the general population. The main determinants of low vaccine uptake in the region include mistrust between health institutions/staff and marginalized populations (including Roma populations); fears associated with vaccine safety; lack of caregiver knowledge about vaccination and insufficient information provided by health professionals; health professionals perceived as lacking counselling skills, and in some cases, perceptions of them as disrespectful to caregivers; hesitant or negative attitudes towards vaccination by some health professionals; as well as issues relating to procurement, supply, storage and cost of vaccines.

OBJECTIVES

This REA has two research questions: (1) how effective are interventions targeting caregivers, healthcare workers (HCWs) and the community to increase vaccination rates of children ≤5 years old; and (2) what evidence is available linking intermediate vaccination outcomes (such as intention and motivation to vaccinate) and vaccination uptake? The REA took a global perspective and aimed to understand how to increase vaccination uptake in general, as well as apply the body of evidence to make more specific recommendations related to determinants of low vaccination uptake in Europe and Central Asia.

SCOPE OF THE REA

The REA assessed routine vaccination in children ≤5 years old. Targets for the interventions were caregivers, healthcare workers (HCWs) and the community. We defined community as a geographic area, or a group of people sharing at least one common social or cultural characteristic following a definition used by a previous systematic review. We included three caregiver-focussed interventions (provision of information or education; home visits; and non-material incentives [incentives that have no monetary value, for example, social recognition]), three HCW-focussed interventions (training and education; material or monetary incentives; and non-material incentives) and any community collaboration or outreach interventions. For community-based interventions, although we were interested in community interventions generally, we also explored interventions targeting specific community subgroups, including faith-based outreach/outreach using local leaders and outreach to populations on the move.

Outcomes of this review are divided into intermediate and vaccination outcomes. Intermediate outcomes include caregiver knowledge, awareness, attitudes, beliefs and intention to vaccinate; HCW motivation, capacity, attitudes and beliefs; and community awareness and norms. Vaccination outcomes include uptake, coverage, complete vaccination, up-to-date vaccination and vaccination timeliness.

Systematic reviews were the main study design of interest; however, there is an evidence synthesis gap relating to HCW incentives (material and non-material incentives). To fill this synthesis gap, we also included primary studies assessing HCW incentives.

The scope of the review was global. After screening full papers, we made a pragmatic decision to implement a publication date limit of 2015 onwards as a large body of evidence was identified.

METHODS

We ran searches in Medline, Web of Science, PsycINFO, CINAHL, Embase, Epistemonikos, Social Systems Evidence, the Campbell Collaboration and the Cochrane Database of Systematic Reviews. We also searched institutional databases, evidence platforms and the included studies lists of a recent evidence gap map and a scoping review.

A sample of the records were screened and extracted independently by two reviewers, with disagreements resolved by discussion. The remaining records were screened and extracted by a single reviewer. Quality appraisal was undertaken using appropriate tools from the Joanna Briggs Institute.

Data were synthesized using the vote counting method described in the Cochrane Handbook, which categorizes studies by the direction of the effect estimate regardless of the size or statistical significance of the effect. To assist interpretation of the findings, we developed standardized effectiveness statements based on the number of studies identified and the proportion of results in a given direction. Evidence was rated as:

- sufficient evidence (>20 studies with ≥90 per cent of studies showing an effect in one direction),
- some evidence (>20 studies with ≥70 per cent to <90 per cent of studies showing an effect in one direction; or between 10 and 20 studies with ≥90 per cent of studies showing an effect in one direction),
- evidence of no effect (>20 studies with ≥50 per cent to <70 per cent of studies showing an effect in one direction), and
- insufficient evidence to determine (<10 studies, or between 10 and 20 studies with ≥70 per cent to <90 per cent of studies showing an effect in one direction).

We also developed an evidence gap map and assessed the implications of the research for policy both generally and in the context of Europe and Central Asia.

RESULTS

We included 48 systematic reviews and 21 primary studies. The most frequent locations of the studies included across the 48 systematic reviews were North America (22 reviews) and South Asia (23 reviews). The least frequently studied region was Eastern Europe and Central Asia (n=2). The most frequently assessed intervention type was caregiver education; in 42 systematic reviews one or more included study assessed this intervention. Other commonly assessed interventions were collaboration and outreach to the community (31 reviews), caregiver home visits (26 reviews) and HCW training and education (19 reviews). Many reviews assessed combination interventions (32 reviews included one or more studies assessing combination interventions). Vaccination-related

outcomes were the most frequently reported outcomes across the reviews (46 of 48 reviews). Intermediate outcomes were assessed in a limited number of reviews: caregiver outcomes in 11 reviews, HCW outcomes in four reviews and community outcomes in one review. The systematic reviews were commonly rated as high (23 reviews) or moderate (19 reviews) quality.

Among the 21 included primary studies assessing HCW incentives, eight were cluster randomized controlled trials (RCTs) and the remainder were quasi-experimental studies. The most frequent locations assessed were West and Central Africa (n=7), and Eastern and Southern Africa (n=5). One study was conducted in Eastern Europe and Central Asia. Material incentives alone were evaluated in 15 of the 21 studies. Non-material incentives alone were the subject of four studies, while two studies examined both material and non-material incentives. Measures of vaccination uptake were reported by all studies. All the primary studies were rated as high (n=14) or moderate (n=7) quality.

Interventions targeting caregivers

Caregiver information or education

The effectiveness of caregiver education or information on intermediate outcomes is based on the results of 11 systematic reviews. There is *some evidence* that caregiver education used alone has a positive effect on caregiver attitudes. There is insufficient evidence to determine if caregiver education has an impact on intention to vaccinate or caregiver knowledge when used alone. When caregiver education is used in combination with other interventions, there is insufficient evidence to determine effectiveness for any of the intermediate outcomes.

The effectiveness of caregiver education on vaccination outcomes is based on the results of 37 systematic reviews. There is *sufficient evidence* of the effectiveness of caregiver education on vaccination uptake when used alone or in combination with other interventions. Combination interventions were varied and included combinations with other interventions of interest to this REA (e.g., home visits, community outreach, HCW education) as well as other interventions aiming to increase vaccination uptake (reminders, recall, health system changes). Results from meta-analyses conducted by authors of the included systematic reviews suggest that these interventions may be more effective in low- and middle-income countries, when delivered as discussions, and when delivering one rather than multiple vaccines.

Few studies reported both intermediate and vaccination outcomes and therefore the link between intermediate outcomes and vaccination outcomes is unclear. However, some review authors indicated that caregiver education-based interventions are most effective when knowledge and awareness are the main barriers to vaccination.

On 16 June 2022, a Congolese woman waits to receive her second dose of the Pfizer COVID-19 vaccine in Rwamwanja Refugee Settlement, Kamwenge District.

© UNICEF/UN0662868/TIBAWESWA

Caregiver non-material incentives

No studies were identified that assessed the impact of non-material incentives for caregivers within the search period.

Home visits

Twenty-six systematic reviews were identified that included studies assessing home visits to increase vaccination-related outcomes.

Insufficient evidence was found to determine the effectiveness of home visits in combination with other interventions on caregiver knowledge. No studies reported data on other intermediate outcomes (attitudes, beliefs or intention to vaccinate). There is *some*

evidence that home visits used alone increases vaccination uptake and *sufficient evidence* that home visits in combination with other interventions increases vaccination outcomes. Examples of interventions used in combination with home visits include community outreach, health system improvements, HCW education, HCW incentives and caregiver reminders. The results of a meta-analysis suggest that providing specific vaccination advice during home visits has a significant positive effect on vaccination outcomes.

Interventions targeting HCWs

HCW training and education

Nineteen systematic reviews were identified that included studies assessing HCW training and education to increase vaccination-related outcomes. There is insufficient evidence to determine if HCW training used alone or in combination with other interventions impacts intermediate outcomes. There is *sufficient evidence* that HCW training, when combined with other interventions, can have a positive effect on vaccination outcomes, but insufficient evidence to determine when used alone. Many combination interventions were used across the systematic reviews, but examples of interventions used with HCW training include community outreach, health system strengthening and reminders (both for HCWs and caregivers).

HCW non-material incentives

We did not find any systematic reviews addressing the effect of HCW non-material incentives on intermediate outcomes. One primary study assessed public recognition for HCWs and caregivers and found no effect on the number of home visits.

We found insufficient evidence from systematic reviews to determine effectiveness of non-material incentives when used alone on vaccination outcomes. The evidence from six primary studies found no evidence of effect (n=5) or had mixed results (n=1).

There is *some evidence* that non-material incentives, when combined with other interventions, can have a positive effect on vaccination uptake. Examples of interventions used in combination with HCW non-material incentives include reminder and recall, HCW financial bonuses, and training on missed opportunities to immunize.

HCW material incentives

Eight systematic reviews and 19 primary studies were identified that assessed HCW material incentives to increase vaccination-related outcomes.

No evidence was identified from systematic reviews on the effect of HCW material incentives on intermediate outcomes. Three primary studies considered this matter and, generally, the findings indicate no evidence of effect on caregiver or HCW intermediate outcomes, or service quality outcomes.

There is *some evidence* to support the use of this intervention when combined with other strategies, but insufficient evidence to determine the effectiveness for use on its own. Interventions used in combination with HCW material incentives included non-material incentives, HCW training, caregiver education, and improvements to vaccine accessibility and availability. One high-quality meta-analysis found a significant positive effect of bonus payments and enhanced fee-for-service paid to outpatient healthcare providers; however, only two primary studies were included in this review. One primary study reported a significant positive finding with respect to performance-based financing versus usual care; all other studies found no or mixed effects.

Community-based interventions

Community collaboration and outreach

Thirty-one systematic reviews were identified that included studies assessing community collaboration and outreach to increase vaccination-related outcomes.

There is insufficient evidence to determine whether community collaboration or outreach used alone or in combination influences caregiver attitudes, knowledge or awareness. No evidence was identified that assessed caregiver intention to vaccinate or HCW intermediate outcomes.

There is *sufficient evidence* on the effectiveness of community collaboration or outreach used alone or in combination with other interventions on vaccination outcomes. Community collaboration or outreach was combined with many different interventions across the 31 systematic reviews, including HCW training, reminders, caregiver incentives, caregiver education and health system changes.

Community subgroups

We identified limited data on pre-specified community subgroups of interest to this review. Four systematic reviews were identified that included studies assessing faith-based community collaboration and outreach to increase vaccination-related outcomes. There is insufficient evidence to determine whether outreach to faith-based communities used alone or in combination impacts intermediate or vaccination outcomes. Two systematic reviews included studies that assessed migrant populations, refugees or other

populations on the move. Therefore, there was insufficient evidence to determine the effectiveness on either intermediate or vaccination outcomes.

CONCLUSIONS

The review identified a large body of research on vaccine uptake in children and adds to the body of evidence synthesis publications previously undertaken, for example, by the Centers for Disease Control and Prevention's Community Guide to Preventive Services, which undertook many systematic reviews that assessed interventions to increase vaccination uptake (most recent update in 2016). Our REA captures data published in the last seven years and included primary studies on HCW incentives, which allowed us to fill an evidence synthesis gap identified in a recent evidence gap map developed by the International Initiative for Impact Evaluation (3ie) .

We identified limited evidence on the effectiveness of these interventions on intermediate outcomes, such as intention and motivation for caregivers and HCWs. Therefore, this limited our capacity to explore the link between intermediate and final vaccination outcomes.

For vaccination outcomes, we identified *some or sufficient evidence* on the effectiveness for several interventions, including caregiver education alone or in combination with other interventions; home visits alone or in combination; HCW training in combination; HCW material incentives used in combination; HCW non-material incentives used in combination; and community outreach and collaboration, both alone and in combination. There was insufficient evidence to determine the effectiveness of HCW training used alone, HCW material and non-material incentives used alone, faith-based outreach, and outreach to populations on the move.

Of these interventions, the most applicable to the barriers in Europe and Central Asia may be caregiver education, home visits, and community collaboration and outreach. Caregiver education could address the issues of lack of information in some countries in the region and may improve attitudes, knowledge and uptake of vaccination. The intervention may be most effective in populations whose baseline education is low, and when delivered face-to-face. Community outreach and home visits reduce the distance between services and caregivers and may be particularly relevant for populations where access is the main barrier to vaccination uptake. Given the distrust between caregivers, HCWs and the government in some countries in Europe and Central Asia, collaboration with trusted community organizations may be useful to harness pre-established relationships. Insufficient evidence was found to determine the effectiveness of HCW training on intermediate outcomes, so it is unclear if this approach would improve caregivers' perceived lack of HCW knowledge. The selection of interventions needs to be tailored to the local population, but multicomponent interventions were found to be consistently effective.

SUMMARY OF EFFECTIVE INTERVENTIONS TO INCREASE VACCINATION UPTAKE OUTCOMES

Interventions with sufficient evidence of effectiveness

- Caregiver education alone or combined with other interventions
- Home visits combined with other interventions
- HCW training combined with other interventions
- Community collaboration or outreach alone or combined with other interventions

Interventions with some evidence of effectiveness

- Home visits used alone
- Material incentives for HCWs combined with other interventions
- Non-material incentives for HCWs combined with other interventions

Intervention selection and implementation

- Combination interventions were found to be consistently effective
- Interventions should be selected taking into consideration the barriers to uptake of the population, e.g., if baseline education is low, caregiver education/ information may be effective; if accessibility is a barrier, home visits or community outreach may be useful

On 24 January 2023 in Joyabaj, Quiché, Guatemala, a comprehensive immunization and nutrition outreach team, supported by UNICEF thanks to funding from the US Government and other donors, visit the home of Irma Jocotales, 58, and her grandson Jaime, 2 years.

© UNICEF/UN0772676/IZQUIERDO

1. INTRODUCTION

BACKGROUND AND RATIONALE

Vaccination is one of the most effective measures for preventing illness, disability and death among children. The vaccination schedule recommended by UNICEF for children ≤5 years is summarized in Appendix A and includes vaccines against diphtheria, tetanus and pertussis (DTP), hepatitis B (HepB), *Haemophilus influenzae type b* (Hib), pneumococcal disease, polio, measles, mumps, rubella, varicella (chicken pox) and rotavirus. Current vaccination coverage is insufficient to provide protection to all children and in 2019, of the estimated 5.3 million deaths globally of children under 5 years old, approximately 21.7 per cent were due to vaccine-preventable diseases (Perin et al., 2021).

Table 1 summarizes the vaccination rates of four European and Central Asian countries and shows that although vaccination rates are high in the overall region, the rates between countries and over time vary greatly (UNICEF & WHO, 2021). A study by Obregon et al. (2020) explored the main determinants of low vaccination in Europe and Central Asia through a literature review, interviews with global immunization experts, and interviews and focus group discussions with caregivers and health providers in Bosnia and Herzegovina, Republic of Moldova, Romania and Ukraine. In Europe and Central Asia, caregivers reported their knowledge on vaccination as insufficient, and attributed this to a lack of information

provided by the health provider. This information asymmetry eroded trust between the caregiver and the HCW, and fuelled perceptions of corruption and lack of transparency in the vaccine procurement process (Obregon et al., 2020). Attitudes towards childhood vaccination were also related to negative experiences with vaccination services. Caregivers complained about waiting times and sharing waiting rooms with other children and clients who were sick, when accessing their appointments (Obregon et al., 2020).

Another determinant of low vaccination uptake in the region is HCWs' attitudes towards immunization. For example, some parents in Ukraine were of the perception that health providers did not vaccinate their own children and were responsible for disseminating anti-vaccination propaganda (Obregon et al., 2020). The health professionals' predisposition towards vaccination, and their confidence or lack of confidence in the national immunization programme, may be an important predictor of caregivers' vaccine behaviour.

Vulnerable and marginalized communities in Europe and Central Asia face specific issues with respect to vaccination. Roma communities may have negative attitudes and mistrust of health institutions, leading to lower immunization coverage compared with non-Roma populations (Obregon et al., 2020). Even when aware of available immunization services, they may feel stigmatized, or discriminated against, and base their immunization decisions on past experience with the health system. Children of refugees tend to have limited access to vaccination services because of a lack of documentation or registration. Migrant populations are often under-vaccinated with higher dropout rates, and there is some evidence that Orthodox populations in the region hold beliefs that do not support vaccination (Wilder-Smith & Qureshi, 2020).

Other determinants of low vaccination uptake identified in the region were fears of vaccine safety and issues relating to procurement, supply, storage and cost of vaccines.

TABLE 1: Proportion of children vaccinated against diphtheria, tetanus, pertussis (DTP3), measles (MCV1) and polio (Pol3) in selected countries in the Europe and Central Asia region, and in the region overall (data from UNICEF WUENIC analytics (UNICEF & WHO, 2021))

Country	DTP3		MCV1		Pol3	
	2015	2021	2015	2021	2015	2021
Bosnia and Herzegovina	82%	73%	83%	68%	74%	73%
Republic of Moldova	87%	87%	89%	83%	88%	88%
Romania	89%	86%	86%	86%	89%	86%
Ukraine	23%	78%	56%	88%	51%	78%
Europe and Central Asia region	91%	94%	94%	95%	93%	94%

Abbreviations: DTP3: third dose of diphtheria, tetanus and pertussis vaccine; MCV1: first dose of measles-containing vaccine; Pol3: third dose of polio vaccine.

This REA was commissioned by UNICEF Innocenti to summarize the impact of interventions targeting caregivers, HCWs, and the community on vaccination-related outcomes – both intermediate outcomes (vaccination knowledge, awareness, attitudes/beliefs, intention to vaccinate), and final vaccination uptake outcomes. The REA assessed global data and considered the applicability of the evidence to vaccination barriers generally, and with the aim of informing future research priorities, policy, interventions and programming in Europe and Central Asia.

Our review adds to the body of evidence synthesis publications that are already developed by organizations including the Centers for Disease Control and Prevention's Community Guide to Preventive Services (who undertook many systematic reviews that assessed interventions to increase vaccination uptake – most recent update in 2016), 3ie (who undertook an evidence gap map [EGM] on vaccination uptake) and the WHO (who undertook a scoping review on interventions to improve vaccine uptake) (Centers for Disease Control and Prevention, 2022; Engelbert et al., 2021; Heneghan et al., 2021). Our REA is unique as it captures systematic reviews published in the last seven years and also includes primary studies on HCW incentives, which allowed us to fill an evidence synthesis gap identified in a recent EGM (Engelbert et al., 2021).

RESEARCH QUESTIONS AND AIMS

The REA utilized primary studies and systematic reviews to answer the following research questions:

- How effective are interventions targeting caregivers, HCWs and the community to increase vaccination rates of children ≤5 years old?
- What evidence is available on the link between intermediate outcomes (such as knowledge, intention and motivation) with vaccination uptake?

By answering these research questions, the REA aimed to:

a. Develop a conceptual framework linking intention and motivation to vaccinate with vaccination uptake.
b. Identify evidence gaps in the literature, taking a global perspective.
c. Provide an evidence base to inform and support policy decisions on interventions that increase vaccination uptake.

Nurses in Kosovo immunizing children when COVID-19 vaccination programme was resumed

2. THE SCOPE OF THIS REVIEW

Section 2 details the scope of this REA and includes a summary of the eligibility criteria and a conceptual framework that summarizes how the interventions may lead to behavioural change and ultimately vaccination uptake.

ELIGIBILITY CRITERIA

The inclusion and exclusion criteria for the REA are presented in Table 2.

Population

The REA focussed on routine vaccination of children ≤5 years old (vaccination schedule included in Appendix A). The populations being targeted by the intervention included parents, caregivers, expectant parents or caregivers (referred to collectively as caregivers for the remainder of the document), HCWs and community members. We defined community as a geographic area, or a group of people sharing at least one common social or cultural characteristic following a definition used by a previous systematic review (Saeterdal et al., 2014).

Intervention and comparator

Barriers to vaccination in Europe and Central Asia are varied, and although we recognize that there are practical barriers to vaccination in Europe and Central Asia (including, but not limited to, procurement issues, cold chain shortcomings and costs), we primarily focussed on interventions targeting vaccine acceptance and demand-based barriers.

We included three caregiver-focussed interventions (provision of information or education; home visits; and non-material incentives), three HCW-focussed interventions (training and education; material or monetary incentives; and non-material incentives) and any community collaboration or outreach interventions. For non-material incentives we included any incentives that have no monetary value, for example, social recognition. For community-based interventions, we were interested in studies assessing any community group, but we also explored interventions targeting two community subgroups: faith-based outreach/outreach using local leaders; and outreach to populations on the move. For all the included interventions, if the systematic review explored outcomes in vaccine-hesitant populations, we also included these data.

Studies were only included if there was a comparative component, be it another intervention, a before-and-after comparison, or compared with no additional intervention (i.e., standard of care).

Outcomes

Outcomes in this REA are divided into intermediate outcomes and vaccination outcomes. Intermediate outcomes include caregiver knowledge, awareness, attitudes, beliefs and intention to vaccinate; HCW motivation, capacity, attitudes and beliefs; and community awareness and norms. This was not an exhaustive list as we anticipated that many different surveys and questionnaires would be used to assess vaccine knowledge, attitudes/beliefs, motivation and intention. Therefore, we extracted all data on the intermediate outcomes we identified in the included studies. Vaccination outcomes included uptake, coverage, complete vaccination, up-to-date vaccination and vaccination timeliness.

Study design

During protocol development, we undertook a scoping exercise to understand the breadth of the evidence base on vaccination uptake. This process identified many evidence synthesis publications, including an EGM of interventions to improve childhood vaccination uptake in low- and middle-income countries (Engelbert et al., 2021); a scoping review of interventions to increase vaccination uptake (Heneghan et al., 2021); and a series of systematic reviews by the Centers for Disease Control and Prevention's Community Guide to Preventive Services assessing interventions to increase vaccination uptake (Centers for Disease Control and Prevention, 2022). Therefore, to leverage the body of evidence synthesis publications, we selected systematic reviews as the main study design of interest.

However, we also recognized that the EGM by Engelbert et al. (2021) identified an evidence synthesis gap relating to HCW incentives (material and non-material incentives). To fill this synthesis gap, we included primary studies assessing HCW incentives.

On 24 October 2022 in Pokotylivka, Kharkivska Region, Ukraine, a poster about the importance of vaccination hangs in the wall of the vaccination room at Primary Medical Care Centre No. 1.

© UNICEF/U.S. CDC/UN0749739/CHRISTINA PASHKINA

For systematic reviews that only included one primary study relevant to our REA, we checked if the study had been included in another review. If the primary study was included in another review, we excluded the review with the single relevant primary study. If the primary study was not identified in another review, we included the single-study review. This was the only attempt made to limit duplication of studies included in systematic reviews. We acknowledge that there will be overlap between the primary studies included in the reviews, but we chose to prioritize coverage and recognize that the duplicate counting of some studies is a limitation of our REA.

Other inclusion criteria

The scope of the review was global, although searches were limited to those published in the English language. In our protocol we did not specify any limit on publication year; however, due to the number of full papers that met our inclusion criteria, we implemented a publication date limit of 2015 onwards.

TABLE 2: Eligibility criteria of the REA

	Inclusion criteria	Exclusion criteria
Population	Children aged ≤5 years old eligible for vaccination against routinely targeted diseases: tuberculosis, diphtheria, pertussis, tetanus, *Haemophilus influenzae type B*, hepatitis B, pneumococcal disease, polio, measles, mumps, rubella, varicella (chicken pox) and rotavirus	■ Vaccination against other vaccine-targeted diseases including HPV, influenza or COVID-19 ■ Vaccination of a population in close contact with children (e.g., caregivers)
Interventions	**Caregiver focussed** ■ Provision of information or education ■ Non-material incentives ■ Home visits **HCW focussed** ■ Training and education ■ Material incentives ■ Non-material incentives **Community focussed** ■ Collaborating with selected community groups and networks ■ Subgroups of interest: faith-based outreach; promoting outreach to populations on the move Outcome data on vaccine-hesitant populations were also extracted for all interventions Interventions combining a relevant intervention with another intervention were also included	**Caregiver focussed** ■ Material/monetary incentives for caregivers **HCW focussed** ■ Pay-for-performance schemes where incentives are provided to only the health centre and do not include HCW bonuses. If the incentive was non-monetary (e.g., sense of team achievement), it was included ■ Incentives targeting lay community HCWs were excluded ■ Interventions targeting the health system only
Comparators	All studies must include a comparison group, for example another behavioural intervention, before and after comparison, or standard of care (where no intervention is delivered)	Studies without a comparison group
Outcomes	Studies that report any of the following outcomes were included: ■ Caregiver knowledge about immunization ■ Caregiver readiness (intention) to vaccinate ■ Caregiver attitudes and beliefs about vaccination, including perception of side effects ■ Community norms ■ Caregiver health service experience ■ HCW motivation and capacity ■ HCW attitudes and beliefs ■ Vaccine uptake	Studies not reporting on outcomes relating to vaccine uptake, or behaviour, intention or motivation of caregivers, HCWs or the community
Context	Global	N/A
Study design	For all interventions we included systematic reviews, REAs, EGMs, scoping reviews and realist reviews For material and non-material incentives for HCWs we also included primary studies (experimental, quasi-experimental, observational)	If a systematic review included only one study, we cross-checked to see if the study was included elsewhere. The review was excluded if the study was previously identified. Primary studies included in an identified systematic review were excluded.

Abbreviations: EGMs: evidence gap maps; HCW: healthcare worker; HPV: human papilloma virus; N/A: not applicable.

HOW INTERVENTIONS MIGHT WORK TO CHANGE BEHAVIOUR AND INCREASE VACCINE UPTAKE

The Capability, Opportunity, Motivation and Behaviour (COM-B) framework is a well-known and accepted behaviour change model (Michie et al., 2011). This theoretical framework posits that desired behaviour change occurs when there is interaction between three necessary conditions – capability, opportunity and motivation. We incorporate these three aspects with respect to childhood vaccine decision-making.

Our conceptual diagram illustrates the main pathways through which interventions can potentially impact childhood vaccination uptake (*see Figure 1*). The model distinguishes between 'vaccination uptake' as the *final outcome*, or ultimate objective of the individual or combined interventions, and *intermediate outcomes*, which are the links in the causal chain. To increase acceptance and uptake of childhood vaccinations, we hypothesize that behaviour change must occur at three levels – the caregivers of children, HCWs and the community – and within the three COM-B domains.

Vaccine acceptance begins with correct knowledge, awareness and attitudes, which could then lead to the intention to vaccinate, and finally receipt of immunization by children ≤5 years old. Community and social norms also directly influence the intention to vaccinate. In our model, 'intention to vaccinate' is an expression of vaccine acceptance. Similar to Kaufman et al. (2018), we treat 'intention' as a separate outcome, more directly preceding the change in behaviour (uptake of the vaccine). We therefore differ from scholars such as Saeterdal et al. (2014), who treat 'intention to vaccinate' as part of the caregivers' 'attitudes' or beliefs about vaccination.

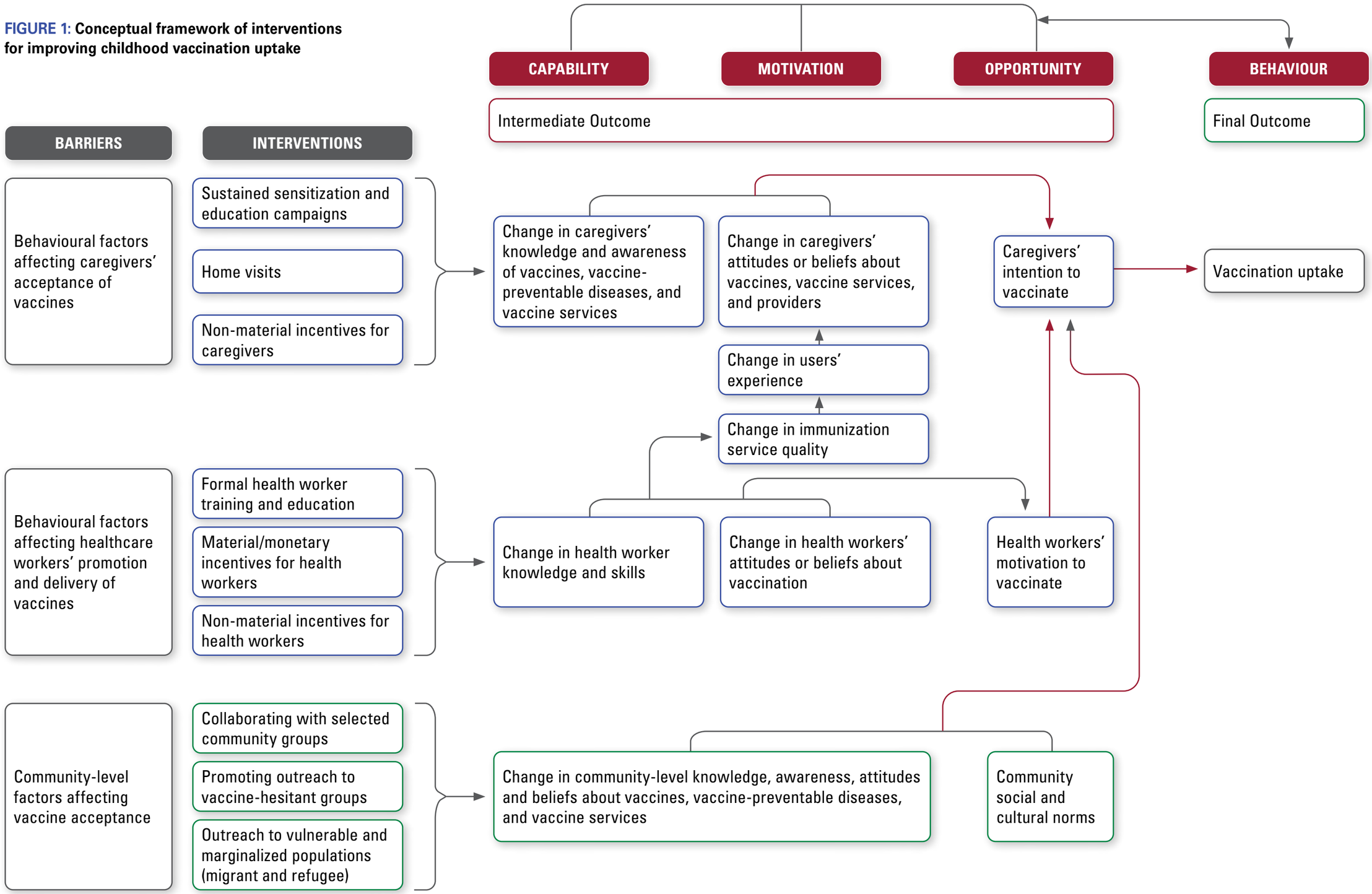
The framework depicts the important role health professionals and the community play in influencing vaccine decision-making at the individual level. Recommendations from health providers are known to be a strong predictor of acceptance (Brewer & Fazekas, 2007; Radisic et al., 2017), and community-based strategies can directly target defaulting or hesitant caregivers (Kaufman et al., 2018; Ryman et al., 2008; Saeterdal et al., 2014; Shea et al., 2009). Combined or multifaceted interventions are likely to be more effective in moving the caregiver along the continuum from hesitant to accepting.

We recognize that the pathway from improved knowledge to changes in attitudes to acceptance and eventual receipt or uptake of vaccination is not linear.

On 11 January 2021, a four-year-old girl receives Vitamin A from a polio vaccinator in Lahore during Pakistan's first national campaign of the year, aiming to vaccinate over 40 million children under five years of age against polio and provide Vitamin A supplementation.

Caregivers may vacillate along the vaccine hesitancy continuum. In addition, behaviour change interventions by themselves will be insufficient to increase vaccination uptake if there are availability problems, for example, vaccine procurement, storage or distribution constraints, or accessibility issues such as high travel cost faced by caregivers to access services. Our model does not attempt to overcome issues of vaccine supply; instead, it addresses the question of how to increase vaccine acceptance and demand when supply is readily available.

FIGURE 1: Conceptual framework of interventions for improving childhood vaccination uptake



On 11 January 2021, girls aged three to five years, in Lahore, Pakistan, welcome the polio vaccination team to their neighborhood.

3. METHODS

This section outlines the methodology used to undertake this REA and includes the search strategy, approach to screening and data extraction, quality appraisal, evidence synthesis and potential limitations. The methods for this REA followed the guidelines included in the UNICEF Innocenti Methodological Briefs on Evidence Synthesis (Bakrania, 2020).

SEARCH STRATEGY

We ran searches in the following databases: Medline (EBSCO), Web of Science (Clarivate), PsycINFO (EBSCO), CINAHL (EBSCO), Embase, Epistemonikos, Social Systems Evidence, the Campbell Collaboration and the Cochrane Database of Systematic Reviews. Institutional databases and evidence platforms were also searched: 3ie database, European Centre for Disease Prevention and Control, WHO, UNICEF, and the Community Guide. In addition, we screened the shortlisted studies from the scoping review by Heneghan et al. (2021).

Searches were designed by an information specialist (GS) and included free-text terms for children, vaccination, caregivers/HCWs/community, the interventions of interest and relevant study designs. Where index terms were available in a database, these were used in addition

to free-text terms. The searches were stratified by study design, with one search designed to capture systematic reviews for all interventions and a second to capture primary studies for HCW incentives. Search strategies are presented in Appendix B.

SCREENING AND DATA EXTRACTION

Abstracts were deduplicated and screened using EPPI-Reviewer (Thomas et al., 2020). Five per cent of abstracts were screened in duplicate by John O'Rourke (JOR) and Andrea Camille Yearwood (ACY) using the inclusion criteria in Table 2. After 5 per cent of the abstracts were screened, consensus between the two reviewers was assessed to ensure that inter-rater reliability was ≥80 per cent. Disagreements were resolved by discussion. The remaining 90 per cent of abstracts were screened by a single reviewer. The same screening process was used for full-paper review.

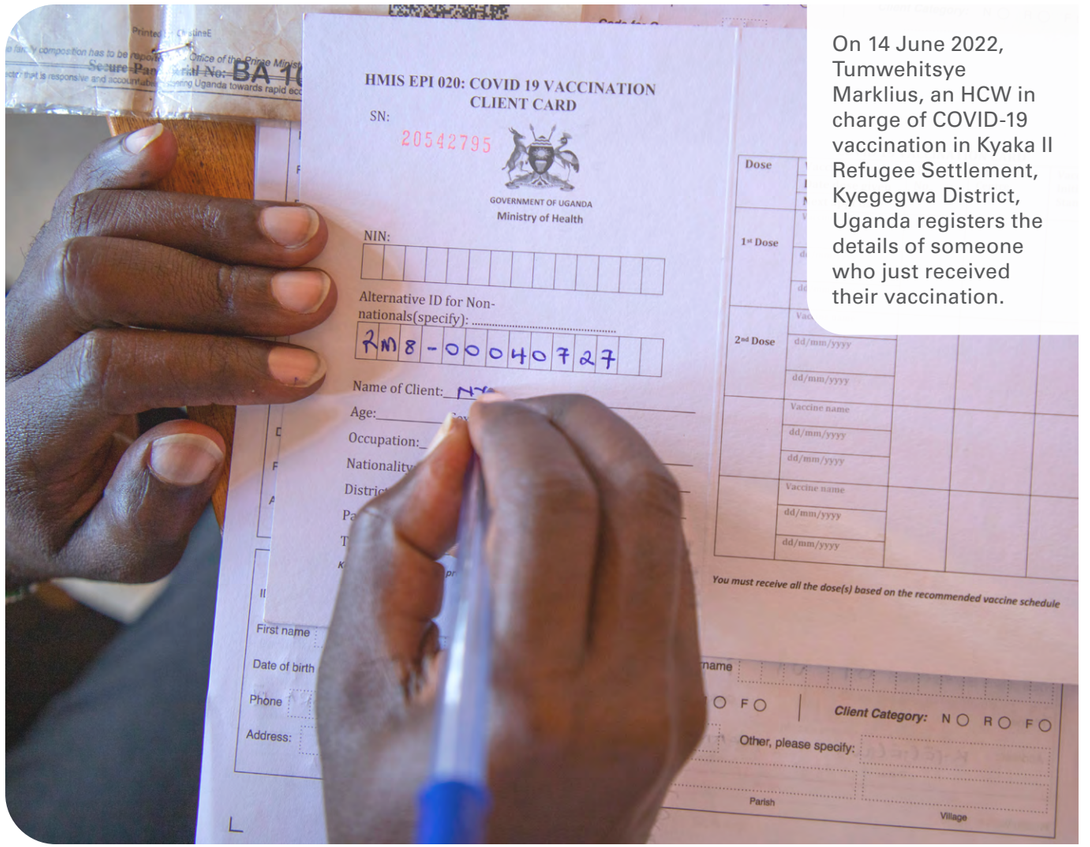
EPPI-Reviewer was used for data extraction and quality appraisal. Extraction was performed by one member of the review team, and the extracted data from 10 per cent of the included studies were checked by the second reviewer. Disagreements were resolved by discussion. The remaining studies were extracted by a single reviewer. Quality appraisal is discussed in detail below.

SYNTHESIS OF RESULTS AND REPORT STRUCTURE

Data from systematic reviews were categorized by the target of the intervention (i.e., caregiver, HCW and community), and by the type of intervention (e.g., education, outreach, home visits). For each systematic review, we extracted the key messages and, where possible, quantitative estimates from meta-analysis were extracted (e.g., odds ratios, risk ratios). For primary studies, quantitative estimates were extracted for both vaccine uptake and intermediate behavioural outcomes.

Data synthesis used the vote counting method from the Cochrane handbook (McKenzie, 2022). This involved categorizing studies included in each systematic review into showing benefit (positive direction of effect) or harm (negative direction of effect). This method does not take statistical significance nor effect size into account, only the direction of the effect. Some reviews presented multiple measures of effect which were not always in the same direction, while other reviews only reported 'no effect' and therefore direction was unclear. These studies were categorized as 'mixed or unclear direction of effect'.

The Cochrane Collaboration recommends not relying on statistical significance. This is because underpowered studies could be reported as showing no benefit, and the power of vote counting using statistical significance tends to zero, except with large studies and moderate intervention effect. In addition, we were limited by the information reported in the systematic reviews, which was not always sufficient to determine statistical significance of the included studies.



On 14 June 2022, Tumwehitsye Marklius, an HCW in charge of COVID-19 vaccination in Kyaka II Refugee Settlement, Kyegegwa District, Uganda registers the details of someone who just received their vaccination.

© UNICEF/UN0662884/TIBAWESWA

To develop standardized 'effectiveness statements', we adapted the approach used by Ryan et al. (2014). We categorized the evidence base for an intervention as 'sufficient evidence', 'some evidence', 'evidence of no effect' and 'insufficient to determine'. These statements were based on the number of studies identified for an intervention and the proportion that reported an effect in a given direction (see *Table 3* for definitions). The cut-offs for categorization were selected based on the size of the overall body of evidence. Relatively high cut-offs were chosen to compensate for the overlap in the primary studies included across the systematic reviews and therefore reduce the impact of studies being counted multiple times. To assist interpretation, we also generated figures summarizing the number of studies and direction of effect for each intervention category (presented in Section 5, Section 6 and Section 7).

The evidence was also used to determine the validity of our conceptual framework and evaluate if there was evidence that intermediate behavioural outcomes (e.g., knowledge, intention and motivation) led to improved vaccination rates (presented in Section 8).

TABLE 3: Criteria used to establish standardized 'effectiveness statements'

Rating	Interpretation	Based on:	
		Number of studies	Proportion of studies reporting effect in one direction
Sufficient evidence	Body of evidence suggests that the intervention is beneficial (if effect is in positive direction) or harmful (if effect is in negative direction)	>20	≥90%
Some evidence	Current body of evidence suggests that intervention may be beneficial (if effect is in positive direction) or harmful (if effect is in negative direction) but more evidence needed (e.g., monitoring and evaluation following implementation)	>20	≥70% and <90%
		>10, ≤20	≥90%
Evidence of no effect	Evidence that the study effects may be distributed around the null hypothesis of no difference (50%)	>20	≥50% and <70%
Insufficient evidence to determine	Too few studies identified or results too mixed to determine effectiveness	≤10	N/A
		>10, ≤20	≥70% and <90%

An EGM was developed using EPPI-Mapper to provide a visual representation of the evidence base (presented in Section 8).

Narrative syntheses were used to discuss implementation considerations generally and the applicability of the evidence to Europe and Central Asia (presented in Section 9).

QUALITY APPRAISAL

All study designs are associated with biases that may impact the design, conduct or analysis. To assess study quality, we used quality appraisal tools designed by the Joanna Briggs Institute. The Joanna Briggs Institute has developed critical appraisal tools for several study designs, including RCTs, quasi-experimental studies and systematic reviews. The checklists used for each of the study designs are included in Appendix D.

Quality appraisal was conducted by a single reviewer (by JOR or ACY). Ten per cent of the quality appraisals (across different study designs) were reviewed by a second reviewer to ensure consistency. Agreement was reached on classification of risk across each study type. The Joanna Briggs Institute coding format of Yes/No/Unclear/Not applicable was used for all studies. By selecting critical appraisal tools developed by one organization, it allowed more uniform assessment of bias across study designs. For each question that a study was coded as 'Yes', the review was awarded 1 point. Studies were categorized as low, moderate or high quality based on the results of the appraisal checklists; systematic reviews: 0–3=low quality, 4–7=moderate quality, 8–11= high quality; RCTs: 0–4=low quality, 5–9=moderate quality, 10–13=high quality; quasi-experimental studies: 0–3=low quality, 4–6=moderate quality, 7–9=high quality.

CHANGES FROM THE PROTOCOL

We made three changes to our inclusion criteria after the protocol was developed. As mentioned in Section 2, we added a publication year limit to our REA (2015 onwards), which was a pragmatic decision based on the number of studies that met our inclusion criteria. We included audit and feedback as type of non-material incentive for HCWs. Finally, during screening we realized that the information provided in the systematic reviews on the duration of sensitization campaigns for caregivers was limited in some systematic reviews. Therefore, to accommodate this, we adopted a broad approach and included any studies assessing provision of information or education to caregivers.

On 21 February 2019, sisters Vitalina and Yuliana Kechur, 6, are comforted by the doctor before their MMR vaccination in Lapaivka village school, Lviv region, western Ukraine, during a three-week catch-up vaccination campaign to increase MMR coverage among school children in the region.

4. SUMMARY OF INCLUDED STUDIES

RESULTS OF THE SEARCH

Database searches were run on 21 March 2022. After deduplication, 1,659 abstracts were identified. These abstracts were screened together with the included studies list of the EGM by Engelbert et al. (2021) and the scoping review being undertaken by Heneghan et al. (2021). Seventy-three systematic reviews and 34 primary studies met our inclusion criteria. Given the volume of evidence, we introduced an additional pragmatic criterion to limit the REA to studies published from 2015 onwards. This resulted in 48 systematic reviews being included and 21 primary studies being included. Appendix E includes a PRISMA flow diagram summarizing the number of included and excluded studies at each stage of the review.

STUDY CHARACTERISTICS – SYSTEMATIC REVIEWS

Throughout the report, the number of included studies in a systematic review refers to the number of studies that assessed caregiver, HCW and community interventions relevant to our REA rather than all studies identified in the systematic review.

Study location: The locations of studies included in systematic reviews are illustrated in Figure 2. The most frequently included countries were the USA (22 reviews), India (20 reviews), Pakistan (17 reviews), UK (11 reviews) and Canada (10 reviews). The most frequently studied regions were North America (22 reviews) and South Asia (23 reviews)

(*see Figure 3*). The least frequently studied regions were Eastern Europe and Central Asia (n=2). Country income classifications most frequently represented in the systematic reviews were high-income countries (27 reviews) and lower-middle income countries (26 reviews).

Vaccine type: Most reviews included one or more studies assessing DTP (30 reviews). Other commonly assessed vaccines were polio (25 studies), MMR (22 studies), HepB (13 reviews), Hib (12 reviews) and anti-tuberculosis (bacille Calmette-Guérin; BCG) vaccine (10 studies). Limited data were identified on varicella (3 reviews) and rotavirus (2 studies) vaccination.

Intervention type: The most frequently assessed intervention type was caregiver education; at least one study assessed caregiver education in 42 systematic reviews. Other commonly assessed interventions were collaboration and outreach to the community (31 reviews), caregiver home visits (26 reviews) and HCW training and education (19 reviews). Interventions that were included in a more limited number of reviews were HCW material incentives (8 reviews), HCW non-material incentives (5 reviews), faith-based outreach (4 reviews), and outreach to populations on the move (2 reviews). Many reviews assessed combination interventions (32 reviews included one or more studies assessing combination interventions).

Outcomes: Vaccination-related outcomes were the most frequently reported outcomes across the reviews (46 out of 48 reviews). Among the vaccination outcomes, uptake (25 reviews), coverage (23 reviews) and complete or full vaccination (14 reviews) were the most common.

Intermediate outcomes were assessed in a limited number of reviews: caregiver outcomes (11 reviews), HCW outcomes (4 reviews) and community outcomes (1 review).

Quality: A summary of the quality of included systematic reviews is provided in Appendix F. Systematic reviews were commonly rated as high (23 reviews) or moderate (19 reviews) quality. Six reviews were rated as low quality. Low-quality reviews performed poorly due to unclear inclusion criteria, did not undertake quality assessment, did not use methods to minimize errors in data extraction and/or did not assess publication bias.

FIGURE 2:

Map showing the number of systematic reviews that included one or more studies set in each country. Darker shading indicates a higher number of systematic reviews with included studies undertaken in that country (range 0 [grey] to 22 [dark blue]). Note: one systematic review did not report the countries that the studies were undertaken in, and a second reported that the included studies were global.

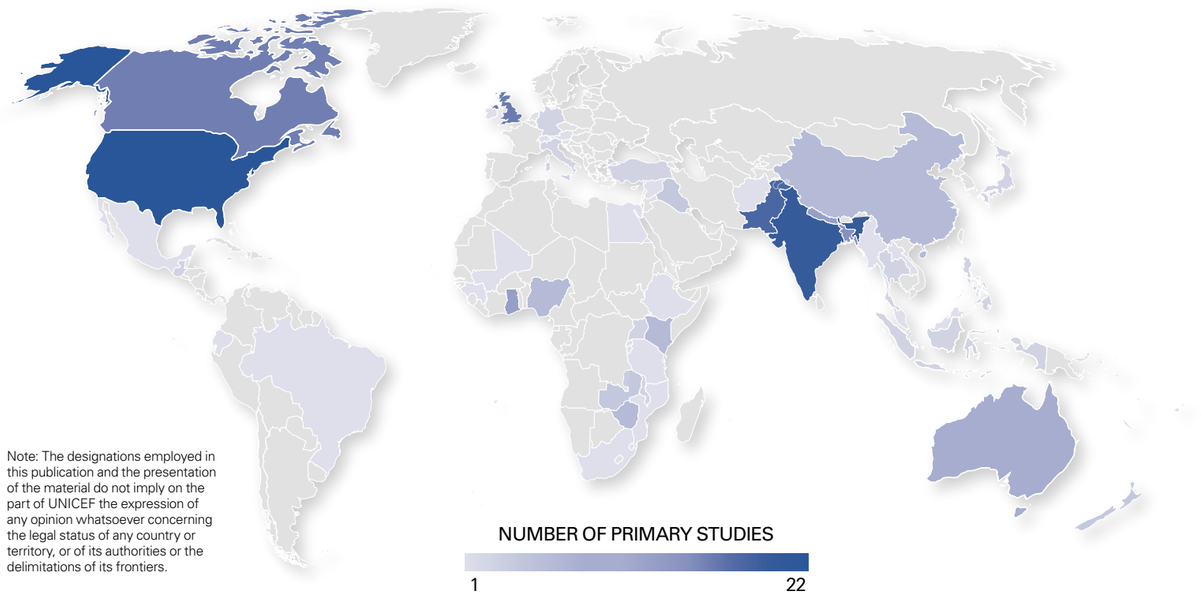
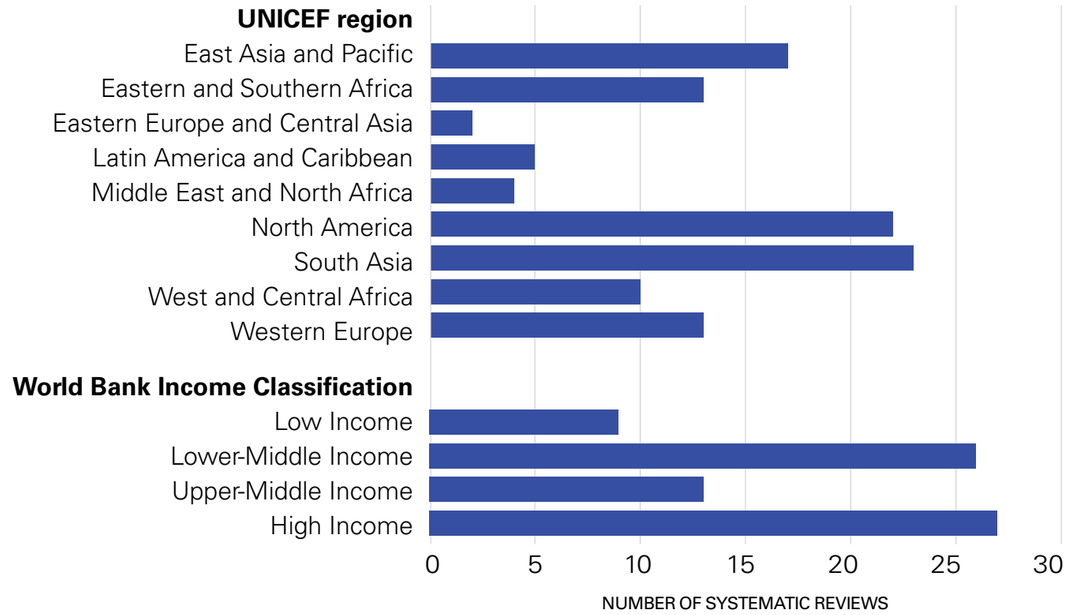


FIGURE 3:

Graph showing the number of systematic reviews that included one or more studies for each of the UNICEF regional classifications, and the World Bank income classifications.



STUDY CHARACTERISTICS – PRIMARY STUDIES

Study location: The location of primary studies was as follows: nine low-income countries, eight lower-middle income, and four high-income countries (*see Figure 5*). Three of the high-income country studies were in the USA and one in Canada (*see Figure 4*). The studies also originated from several UNICEF regions: West and Central Africa (seven studies); Eastern Europe and Central Asia (one study); Eastern and Southern Africa (five studies); North America (four studies); South Asia (two studies); and Latin America and the Caribbean (one study).

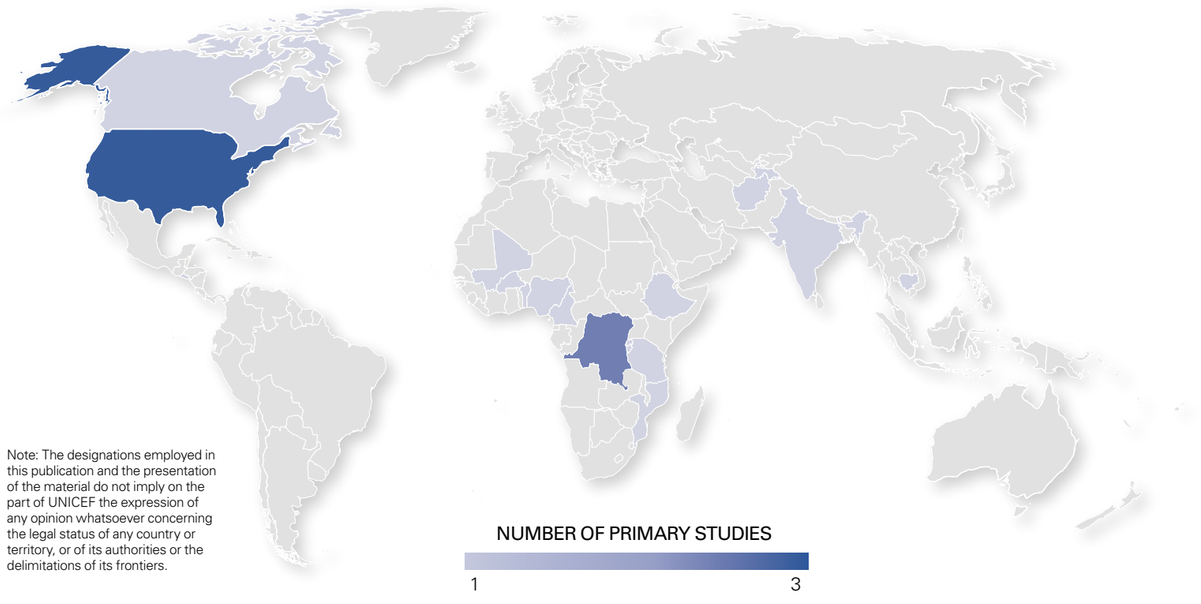
Study design: Eight of the studies were RCTs, and the remainder were quasi-experimental (see *Table 4*). Most of the quasi-experimental studies used the difference-in-difference design (nine studies).

Interventions and outcomes: Most of the primary studies assessed interventions to increase uptake of DTP (nine studies), polio (eight studies), MMR (four studies) and pentavalent vaccine (DTP, HepB and HibB) (five studies). Material incentives alone were evaluated in 15 of the 21 studies. Non-material incentives alone were the subject of four studies, while two studies examined both material and non-material incentives. Measures of vaccination uptake were the outcome of interest in all studies.

Quality: A summary of the quality of included RCTs and quasi-experimental studies is presented in Appendix F. All the RCTs were rated as high or moderate quality. The questions most frequently answered as 'unclear' or 'no' related to blinding of participants, blinding of those delivering treatment and blinding of outcome assessors. All quasi-experimental studies were rated as high or moderate quality. Questions that were most frequently answered as 'unclear' related to similarity of participants in the comparison group, the availability of multiple measurements pre- and post-intervention and the reliability of outcomes measures.

Additional details on the interventions and outcomes assessed in the primary studies are available in Appendix C.

FIGURE 4:
World map illustrating the location of each of the included primary studies. Dark blue indicates more studies (upper range=3). No primary studies were identified for countries shaded grey.



Note: The designations employed in this publication and the presentation of the material do not imply on the part of UNICEF the expression of any opinion whatsoever concerning the legal status of any country or territory, or of its authorities or the delimitations of its frontiers.

FIGURE 5:
Graph showing the number of primary studies that were undertaken in each of the UNICEF regional classifications, and the World Bank income classifications.

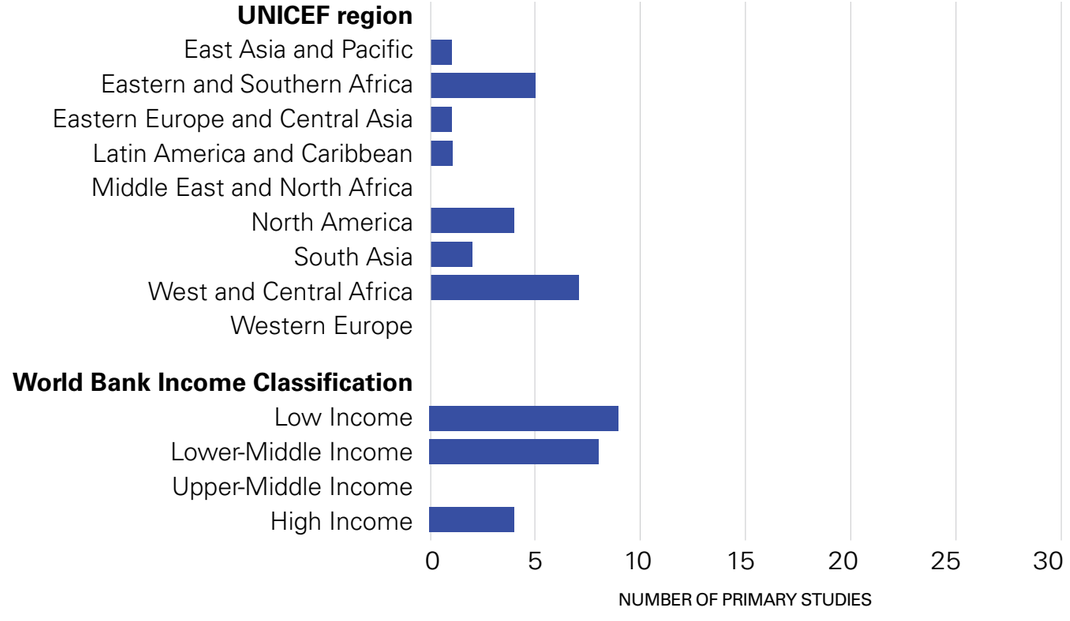


TABLE 4: Study characteristics of primary studies

Author (Year)	Study design	Country	Intervention class	Vaccines	Outcomes
Ahmed et al. (2019)	Quasi-experimental study	Tajikistan (rural residence)	Financial bonus	MMR	Vaccination
Bernal & Martinez (2020)	Cluster RCT	El Salvador	Employer recognition, performance feedback, social comparison, material incentives	MMR	Vaccination
Binyaruka et al. (2015)	Quasi-experimental study	Tanzania	Financial bonus	Measles, pentavalent, polio vaccine	Vaccination
Bond et al. (2019)	Quasi-experimental study	United States	Performance feedback	Rotavirus, Combo 3, (includes DTP, IPV, MMR, Hib, HepB, VZV and PCV)	Vaccination
Carmichael et al. (2019)	Cluster RCT	India (rural districts)	HCW training, material goods, employer recognition	DTP, measles	Vaccination
Cyrus et al. (2016)	Cluster RCT	Afghanistan (primary care facilities)	Financial bonus	Pentavalent	Vaccination
de Walque et al. (2021)	Cluster RCT	Cameroon	Financial bonus, and audit and feedback	BCG, measles, pentavalent, polio vaccine, yellow fever	Caregiver intermediate, vaccination
Demilew et al. (2020)	Cluster RCT	Ethiopia (urban, semi-urban)	Combined intervention with HCW and caregiver non-material incentives	BCG, DTP, measles HepB, Hib, polio vaccine, rotavirus	HCW intermediate, vaccination
Falisse et al. (2015)	Quasi-experimental study	Burundi	Financial bonus	BCG, DTP, MMR, polio vaccine	Vaccination
Fu et al. (2016)	Cluster RCT	United States	Financial bonus	All needed vaccines	Vaccination
Hu et al. (2016)	Quasi-experimental study	United States	Financial bonus	DTP, MMR, HepB, Hib, polio vaccine, varicella	Vaccination
Huillery & Seban (2021)	Cluster RCT	Democratic Republic of the Congo	Financial bonus	BCG, at least 1 immunization shot	Caregiver intermediate, HCW intermediate, vaccination
Katz et al. (2015)	Quasi-experimental study	Canada (low-income/SES families or communities)	Financial bonus	Not specified	Vaccination
Khanna et al. (2021)	Cluster RCT of PBF and DFF, Control not selected at random= quasi-experimental	Nigeria	Service quality training, financial bonus, audit and feedback	Pentavalent	Caregiver intermediate, HCW intermediate, vaccination
Rajkotia et al. (2017)	Quasi-experimental study	Mozambique	Financial bonus	BCG, DTP, measles, polio vaccine	Vaccination
Salami et al. (2018)	Quasi-experimental study	Benin	Financial bonus	Measles, pentavalent	Vaccination
Sherry et al. (2017)	Quasi-experimental study	Rwanda	Financial bonus	BCG, DTP, measles, polio vaccine	Vaccination
Van de Poel et al. (2016)	Quasi-experimental study	Cambodia	Financial bonus, enhanced fee for service	BCG, DTP3, measles, polio vaccine (OPV3)	Vaccination
Zeng et al. (2018)	Quasi-experimental study	Democratic Republic of the Congo (rural and semi-rural residence)	Financial bonus	BCG, DTP, full immunization	Vaccination
Zizien et al. (2019)	Quasi-experimental study	Burkina Faso	Financial bonus	Not specified	Vaccination
Zombré et al. (2020)	Quasi-experimental study	Mali	Financial bonus	Measles	Vaccination

Abbreviations: BCG: anti-tuberculosis vaccine (bacille Calmette-Guérin); DFF: direct facility financing; DTP: diphtheria, tetanus and pertussis vaccine; HepB: hepatitis B; Hib: *Haemophilus influenzae type b*; IPV: inactivated poliovirus vaccine; MMR: measles, mumps and rubella vaccine; OPV3: third dose oral polio vaccination; PBF: performance-based financing; PCV: pneumococcal conjugate vaccine; RCT: randomized controlled trial; SES: socio-economic status; VZV: varicella-zoster virus.

On 7 August 2015, Ritu Rani, an auxiliary nurse and midwife, and women with their child or grandchild pose for a photograph inside Anganwadi Centre in Begusarai, Bihar, India.

5. THE EFFECT OF INTERVENTIONS TARGETING CAREGIVERS

The effects of interventions targeting caregivers are presented below. The ratings of effectiveness are based on the criteria outlined in Section 3.

PROVISION OF EDUCATION OR INFORMATION TO CAREGIVERS

Studies are included in this section if the intervention aims to inform or educate caregivers about the importance of immunization and immunization services using different delivery modalities. These interventions could be delivered as single or combined strategies.

Intermediate outcomes

The effectiveness of caregiver education or information on intermediate outcomes is based on the results of 11 systematic reviews (*see Figure 6*) (Akojie, 2021; Baptista, 2018; Bruel et al., 2020; de Cock et al., 2020; Freeman et al., 2017; Hakim et al., 2019; Jarrett et al., 2015; Kaufman et al., 2018; Olson et al., 2020; Vujovich-Dunn et al., 2021; Watterson et al., 2015).

There is *some evidence* that caregiver education used alone can have a positive effect on caregiver attitudes. This is based on nine out of nine studies (100 per cent) in a positive direction, plus a meta-analysis of three studies in a positive direction (but not statistically significant). There is insufficient evidence to determine if caregiver education used alone has an impact on other intermediate outcomes: for intention to vaccinate, four out of four studies (100 per cent) were in a positive direction, plus a meta-analysis of two studies in a statistically positive direction; for knowledge of vaccines and vaccination availability/schedule, four out of four studies (100 per cent) were in a positive direction, plus a meta-analysis of four studies was in a positive direction; for anxiety, one out of one (100 per cent) study was in a positive direction; for decision-making, four out of four studies (100 per cent) were in a positive direction; and for perception of rare adverse events of vaccines, two out of two studies (100 per cent) were in a positive direction.

There is insufficient evidence to determine the effectiveness of caregiver education used in combination with other interventions (see examples in *Box 1*) on any of the intermediate outcomes, including attitudes and beliefs (1/1 study in positive direction), knowledge of vaccination (4/4 studies in positive direction) and actual or intended behaviour (1/1 study).

Vaccination outcomes

The effectiveness of caregiver education or information on vaccination outcomes is based on the results of 37 systematic reviews (*see Figure 7* and *Figure 8*) (Abdulrahman & Olaosebikan, 2017; Akojie, 2021; Baptista, 2018; Bright et al., 2017; Bruel et al., 2020; CPSTF, 2015a, 2015b, 2015d, 2016; Crocker-Buque et al., 2017a, 2017b; Crocker-Buque & Mounier-Jack, 2018; de Cock et al., 2020; Deardorff et al., 2018; Gera et al., 2016; Harvey et al., 2015; Jaca et al., 2018; Jacobson et al., 2018; Jarrett et al., 2015; Johri et al., 2015; Juni & Afiah, 2018; Kaufman et al., 2018; Kim et al., 2017; Lukusa et al., 2018; Machado et al., 2021; Molina et al., 2016; Mureed et al., 2015; Nelson et al., 2016; Nour, 2019; Oliver-Williams et al., 2017; Omoniyi & Williams, 2020; Oyo-Ita et al., 2016; Ozawa et al., 2018; Pal et al., 2016; Palmer et al., 2020; Vedio et al., 2017; Vujovich-Dunn et al., 2021; Wang et al., 2016).

There is *sufficient evidence* (28/31 studies [90 per cent] in positive direction) on the effectiveness of caregiver education alone on vaccination outcomes. However, of the 19 reviews that were relevant to this section, most (17/19) included three or fewer studies.

There is *sufficient evidence* that caregiver education in combination with other interventions improves vaccination outcomes (94/97 studies [97 per cent]). Examples of combination interventions including education of caregivers are presented in Box 1.

IMPLEMENTATION CONSIDERATIONS

Association between intermediate and vaccination outcomes

Few studies reported both intermediate and vaccination outcomes, and therefore the pathway from intermediate outcomes to vaccination outcomes, needs additional research. However, several reviews indicated that caregiver education-based interventions are most effective when knowledge and awareness are barriers to vaccination (Harvey et al., 2015; Johri et al., 2015; Kaufman et al., 2018; Lukusa et al., 2018). Two reviews included meta-analyses highlighting that caregiver education appears to have greater effect in low- and middle-income countries (L&MIC) and hypothesize that this may be due to baseline education levels (Harvey et al., 2015; Lukusa et al., 2018). If awareness is low at baseline, information and education may show greater effect in settings other than those where hesitancy is the barrier to vaccination (Kaufman et al., 2018).

BOX 1: EXAMPLES OF COMBINATION INTERVENTIONS INCLUDING EDUCATION OF CAREGIVERS

- Telephone and postcard reminders, immunization schedulers, brochures, intervention area task force activities, posters, bumper stickers, magnets, presentations, door-to-door education
- Computerized tracking and reminders, caregiver and HCW education, HCW incentives, caregiver incentives and home-visiting outreach
- Face-to-face information delivered by a social worker, with immunization camps and caregiver incentives
- Redesigned immunization cards and centre-based education
- Health promotion for children delivered by community HCWs, illness management, community development

Subgroup analyses from meta-analyses

Seven studies included meta-analyses, and the main analysis in each study showed a significant positive effect of caregiver education on vaccination outcomes. Subgroup analyses suggest that the effectiveness may be impacted by several factors. In addition to the meta-analysis of education interventions in L&MIC (discussed above), Harvey et al. (2015) also found that education and information was more effective if delivered as a discussion rather than in written form, but there was no effect of timing of education (at birth or postnatally). Kaufman et al. (2018) assessed only face-to-face interventions and found that short-duration interactions (1–10 minutes) significantly improved vaccine uptake, and long-duration interactions (11+ minutes) had no effect, although the test of differences between subgroups was not significant and the authors advise that more research is needed. Kaufman et al. (2018) also reported a significant improvement in vaccine uptake when delivering single vaccines but not when delivering multiple vaccines (test for subgroup differences was significant), which the authors attribute to single vaccination being less demanding compared with multiple vaccines.

Format of education/information

As shown in the meta-analyses, delivery of information in a discussion format was more effective than in written format; however, these interventions are costly and time-consuming. Therefore, Harvey et al. (2015) suggest limiting discussion-based interventions to vaccine-hesitant parents. Another study suggested reserving home-visiting campaigns to persistent non-responders may be more cost-effective than universal home visiting (Crocker-Buque et al., 2017a).

Four reviews included studies on decision aids but covered a limited body of largely overlapping studies (Baptista, 2018; Bruel et al., 2020; Crocker-Buque & Mounier-Jack, 2018; Vujovich-Dunn et al., 2021). The studies suggest that decision aids may improve decision-making and have a slight effect on vaccine uptake but may be most useful in populations where confidence and knowledge are barriers to vaccination (Bruel et al., 2020). Vaccination benefits far outweigh the risks; therefore, decision aids are better suited to those who are undecided about vaccination, not those who are ready to vaccinate (Vujovich-Dunn et al., 2021).

One review reported that reminders and information via letters were effective at increasing vaccination outcomes but conceded that the future may be technology-based strategies which require less manpower (Juni & Afiah, 2018).

Regardless of the delivery approach, materials should not be complex and should be culturally and linguistically appropriate (Wang et al., 2016). Plain language communication is an important ingredient in design and delivery of caregiver education interventions for low socio-economic status parents who may have language barriers, low health literacy, and low confidence interacting with healthcare providers (Machado et al., 2021).

Olson et al. (2020) identified five characteristics of effective information/communication. This included using multicomponent strategies; using a variety of media or touchpoints; incorporating an element of dialogue; ensuring that information was personalized and tailored to specific vaccine concerns, historical experiences, religious or political affiliations, socio-economic status; and trusted information messengers.

Vaccine hesitancy

Two of the reviews only included studies that assessed strategies in vaccine-hesitant populations (Jarrett et al., 2015; Olson et al., 2020). There is insufficient evidence to determine the effectiveness of interventions that include a caregiver component on intermediate or final vaccination outcomes, but the limited evidence suggests that provision of education/information may have a positive impact on caregiver attitudes (5/5 studies in positive direction) and on vaccine uptake (8/8 studies in positive direction). Jarrett et al. (2015) suggest that efforts to understand the target audience and dialogue-based approaches may be suitable for vaccine-hesitant populations.

Other considerations

Several reviews indicated that effective educational interventions should target specific communities (Crocker-Buque et al., 2017a; Deardorff et al., 2018; Jarrett et al., 2015; Nelson et al., 2016). Recommendations included identifying and targeting information to

On 7 December, 2022, Israt Jahan Tania, 26, is at home with her 16-month-old son, Hasnat Ahmadullah, in Karail, Dhaka, Bangladesh.

© UNICEF/UN0757335/RAHMAN

pre-identified high-risk communities, utilizing multicomponent and locally constructed interventions, and addressing knowledge gaps specific to the community, especially if demand-side barriers are influencing vaccination rates (Crocker-Buque et al., 2017a; Deardorff et al., 2018; Nelson et al., 2016).

Several of the reviews note that increase in the demand for childhood vaccination with caregiver education needs to be matched by supply (Johri et al., 2015; Nelson et al., 2016; Oliver-Williams et al., 2017). Vaccine uptake will be limited by supply-side constraints such as the health system not being able to respond to the increase in demand.

The only review that included two studies in a negative direction was Gera et al. (2016). Gera et al. (2016) were assessing strategies for integrated management of childhood illness and included two studies that assessed caregiver education as part of complex integration management strategies. One of the included studies found no effect on vaccination (although the direction was negative) and the second found a significant negative effect on vaccination. The review authors did not explore the rationale for this finding.

FIGURE 6:

The effect of provision of education or information to caregivers on intermediate outcomes from a) meta-analyses, and b) narrative synthesis. Results are presented by whether the intervention was used alone or in combination, and whether the systematic review reported the data in a meta-analysis or narratively. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange) and mixed or unclear direction (grey). A green arrow pointing upwards indicates that the result of the meta-analysis was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect.

a) Meta-analyses from included systematic reviews

Author & Year	Review quality	Number of studies	Outcome	Direction of effect		
				Significant positive effect	No effect	Significant negative effect
Caregiver education/information used alone - meta-analysis of intermediate outcomes						
Kaufman 2018	High	3	Attitudes		↔	
Kaufman 2018	High	2	Intention	↑		
Kaufman 2018	High	4	Knowledge	↑		

b) Studies reported narratively in included systematic reviews

Author & Year	Review quality	Number of studies	Outcome	Number of studies and direction of effect		
				Positive direction	Negative direction	Mixed or unclear direction
Caregiver education/information used alone - data reported narratively						
Kaufman 2018	High	1	Anxiety	1		
de Cock 2020	High	2	Attitudes	2		
Hakim 2019	High	1	Attitudes			1
Olson 2020	Moderate	5	Attitudes	5		
Bruel 2020	Moderate	1	Attitudes	1		
Akojie 2021	Low	1	Attitudes	1		
Freeman 2017	Moderate	1	Awareness	1		
Vujovich-Dunn 2021	High	1	Decision conflict	1		
Bruel 2020	Moderate	3	Decision satisfaction	3		
Hakim 2019	High	1	Intention to vaccinate			1
Vujovich-Dunn 2021	High	1	Intention to vaccinate	1		

Author & Year	Review quality	Number of studies	Outcome	Number of studies and direction of effect		
				Positive direction	Negative direction	Mixed or unclear direction
Baptista 2018	Moderate	2	Intention to vaccinate	2		
Olson 2020	Moderate	1	Intention to vaccinate			1
Akojie 2021	Low	1	Intention to vaccinate	1		
de Cock 2020	High	2	Knowledge	2		
Hakim 2019	High	1	Knowledge	1		
Kaufman 2018	High	1	Knowledge	1		
Vujovich-Dunn 2021	High	1	Perception of rare AE	1		
Akojie 2021	Low	1	Perception	1		
Caregiver education/information used in combination with other interventions – data reported narratively						
Hakim 2019	High	1	Attitudes and beliefs	1		
de Cock 2020	High	3	Knowledge & awareness	2		1
Hakim 2019	High	1	Knowledge	1		
Jarrett 2015	High	1	Knowledge	1		
Watterson 2015	Moderate	1	Actual or intended behaviour	1		

Abbreviations: AE: adverse events

FIGURE 7:

Meta-analyses summarizing the effect of caregiver education or information on vaccination outcomes. Results are presented by overall analysis and subgroup analyses. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. A green arrow pointing upwards indicates that the result of the meta-analysis was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect.

Author & Year	Review quality	Number of studies	Analysis group	Direction of effect		
				Significant positive effect	No effect	Significant negative effect
Caregiver education/information – meta-analysis of vaccination outcomes						
Harvey 2015	High	10	Overall – Caregiver education alone vs comparator	↑	↔	
Kaufman 2018	High	7	Overall – face-to-face education vs control	↑		
Johri 2015	High	7	Overall – education vs control	↑		

Author & Year	Review quality	Number of studies	Analysis group	Direction of effect		
				Significant positive effect	No effect	Significant negative effect
Lukusa 2018	High	6	Overall – parental education vs control	↑		
Harvey 2015	High	5	Overall – education + reminders vs control	↑		
Palmer 2020	High	5	Digital communication via mobile devices vs usual care	↑		
Mureed 2015	Moderate	10	Combined intervention (mainly health education)	↑		
Sub-group analyses						
Harvey 2015	High	7	HIC based studies		↔	
Harvey 2015	High	4	L&MIC based studies	↑		
Harvey 2015	High	6	Parental education postnatally (infant >1 month old)		↔	
Harvey 2015	High	4	Parental education at birth (infant <1 month old)		↔	
Harvey 2015	High	5	Discussion-based interventions	↑		
Harvey 2015	High	5	Written-based education		↔	
Kaufman 2018	High	4	Short (1–10 minutes) duration interactions	↑		
Kaufman 2018	High	3	Long (11+ minutes) duration interactions		↔	
Kaufman 2018	High	4	Delivering multiple vaccines		↔	
Kaufman 2018	High	3	Delivering single vaccines	↑		
Lukusa 2018	High	3	Education at a health facility	↑		
Lukusa 2018	High	3	Education in the community or home	↑		
Jacobson 2018	High	3	Outreach with patient reminder/recall vs no intervention	↑		
Oyo-Ita 2016	High	2	Facility-based education + reminder card vs usual care	↑		
Mureed 2015	Moderate	7	Combined intervention (mainly health education), DTP	↑		
Mureed 2015	Moderate	4	Combined intervention (mainly health education), polio		↔	
Mureed 2015	Moderate	3	Combined intervention (mainly health education), MMR	↑		
Mureed 2015	Moderate	4	Combined intervention (mainly health education), full vaccination		↔	

Abbreviations: DTP: diphtheria, tetanus and pertussis vaccine; MMR: measles, mumps and rubella vaccine; HIC: high-income country; L&MIC: low- and middle-income countries; vs: versus.

FIGURE 8:

The effect of provision of education or information to caregivers on vaccination outcomes. Results are presented by whether the intervention was used alone or in combination. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey).

Author Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Caregiver education/information used alone – vaccination outcomes					
Palmer 2020	High	5	4		1
Crocker-Buque 2018	High	3	2		1
Bright 2017	High	2	1		1
Machado 2021	High	2	1	1	
Vujovich-Dunn 2021	High	2	2		
Jarrett 2015	High	1	1		
Juni 2018	Moderate	4	4		
Oliver-Williams 2017	Moderate	3	2		1
Baptista 2018	Moderate	2		1	1
Bruel 2020	Moderate	2	2		
Crocker-Buque 2017b	Moderate	2	2		
Omoniyi 2020	Moderate	2	1		1
Ozawa 2018	Moderate	2	2		
Deardorff 2018	Moderate	1	1		
Pal 2016	Moderate	1	1		
Abdulrahman 2017	Low	1		1	
Akojie 2021	Low	1			1
Kim 2017	Low	1	1		
Nour 2019	Low	1	1		

Author Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Caregiver education/information used in combination with other interventions – vaccination outcomes					
Crocker-Buque 2017a	High	13	12		1
Harvey 2015	High	13	7		6
Machado 2021	High	11	10		1
Nelson 2016	High	9	8		1
Bright 2017	High	7	4		3
Jarrett 2015	High	7	7		
Gera 2016	High	2		2	
de Cock 2020	High	1			1
Jaca 2018	High	1	1		
Molina 2016	High	1	1		
CPSTF 2015b	Moderate	12	12		
Wang 2016	Moderate	11	11		
CPSTF 2016	Moderate	5	4	1	
CPSTF 2015d	Moderate	4	4		
Juni 2018	Moderate	4	4		
CPSTF 2015a	Moderate	3	3		
Deardorff 2018	Moderate	2	2		
Ozawa 2018	Moderate	2	2		
Oliver-Williams 2017	Moderate	1	1		
Vedio 2017	Low	1	1		

Abbreviations: CPSTF: Community Preventive Services Task Force.

NON-MATERIAL INCENTIVES FOR CAREGIVERS

No studies were identified that assessed the impact of non-material incentives for caregivers.

HOME VISITS

Twenty-six systematic reviews were identified that included studies assessing home visits to increase vaccination-related outcomes (Bright et al., 2017; CPSTF, 2015a, 2015b, 2015d, 2016; Crocker-Buque et al., 2017a; Crocker-Buque & Mounier-Jack, 2018; de Cock et al., 2020; Deardorff et al., 2018; Freeman et al., 2017; Gera et al., 2016; Harvey et al., 2015; Jaca et al., 2018; Jarrett et al., 2015; Johri et al., 2015; Kaufman et al., 2018; Lukusa et al., 2018; Machado et al., 2021; Munk et al., 2019; Nelson et al., 2016; Oliver-Williams et al., 2017; Omoniyi & Williams, 2020; Oyo-Ita et al., 2016; Ozawa et al., 2018; Wang et al., 2016; Watterson et al., 2015).

For home visits, studies were considered 'alone' if home visits were used to educate/inform about immunization or immunize only, while combination interventions included this component plus an additional intervention (see examples in *Box 2*).

Intermediate outcomes

There is insufficient evidence to determine the effectiveness of home visits in combination with other interventions on caregiver knowledge (3/3 studies in positive direction) (*see Figure 9a*). No studies reported data on other intermediate outcomes (attitudes, beliefs, or intention to vaccinate).

Vaccination outcomes

The effectiveness of home visits on vaccination outcomes is based on the results of 25 systematic reviews (*see Figure 9*).

One meta-analysis was identified that assessed home visits by lay HCWs. The overall analysis did not show a significant effect, but a subgroup analysis suggested that if the home visit provided specific vaccination advice, the intervention has a significant positive effect.

There is *some evidence* that home visits used alone increases vaccination uptake. This is based on 11 out of 12 (92 per cent) studies in a positive direction from eight systematic reviews, but the number of studies in each review assessing home visits used alone is low (≤2 studies in each review) and the direction was unclear or mixed in an additional four studies.

There is *sufficient evidence* that home visits in combination with other interventions (see examples in *Box 2*) increases vaccination outcomes. This is based on data from nine high-quality reviews and seven moderate-quality reviews that reported 56/59 studies (95 per cent) had a positive impact on the direction of effect of vaccination outcomes.

BOX 2: EXAMPLES OF COMBINATION INTERVENTIONS THAT INCLUDE HOME VISITS

- Home visits by community HCWs, training in improved case management of sick children, women's groups, strengthening of health systems
- Home visits, community presentations, door-to-door canvassing, dissemination material, reminders, appointments
- Computerized tracking and reminders, caregiver and HCW education, HCW incentives, caregiver incentives and home-visiting outreach
- Home visits, reminders and health passports
- Immunization database, outreach, home visits

Implementation considerations

There was limited evidence on the effect of home visits on intermediate outcomes, therefore the pathway through which this intervention works to increase vaccination uptake is unclear. However, home visits address many barriers to vaccination, including geographical, financial and accessibility barriers (Bright et al., 2017). Home visits can be an important component of successful interventions, particularly in remote areas, in disadvantaged groups and in low socio-economic populations (Machado et al., 2021; Wang et al., 2016). Home visits can also address some cultural barriers to vaccination; Omoniyi and Williams (2020) suggested that home visits were successful in one study because they enabled access for some Muslim women who would not leave their homes due to the purdah system. Combination interventions can target the multi-layered nature of vaccination decision-making. Machado et al. (2021) suggest that successful interventions tended to overcome access barriers (which could include home visits), included a reminder component, educated parents and HCWs, and partnered with community-based organizations. Bright et al. (2017) expressed a similar sentiment, emphasizing the multidimensional nature of barriers to vaccination, and therefore involving community members may increase acceptability of services. Combination interventions selected based on contextual factors and specific barriers are more likely to succeed (Bright et al., 2017).

Based on effectiveness, the Community Preventive Services Task Force (CPSTF) (2016) strongly recommends interventions that include home visits. However, they acknowledge that there are implementation considerations, including being resource-intensive, logistically challenging and difficult in terms of timing. Therefore, home visits may not be feasible in resource-poor settings (Oyo-Ita et al., 2016). There are also considerations relating to safety and the potential security concerns parents may have about having strangers in their homes (CPSTF, 2016).

FIGURE 9:

The effect of home visits on a) intermediate outcomes, b) meta-analyses of vaccination outcomes and c) narrative reporting of vaccination outcomes. Results are presented by whether the intervention was used alone or in combination. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey). A green arrow pointing upwards indicates that the result of the meta-analysis was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect.

a) Intermediate outcomes reported narratively in included systematic reviews

Author & Year	Review quality	Number of studies	Outcome	Number of studies and direction of effect: Positive direction	Negative direction	Mixed or unclear direction
Home visits used in combination with other interventions						
Kaufman 2018	High	2	Caregiver knowledge	2		
de Cock 2020	High	1	Caregiver knowledge and awareness	1		

b) Meta-analyses of vaccination outcomes from included systematic reviews

Author & Year	Review quality	Number of studies	Outcome	Direction of effect: Significant positive effect	No effect	Significant negative effect
Home visits – meta-analysis of vaccination outcomes						
Harvey 2015	High	4	Overallm – home visit vs control		↔	
Harvey 2015	High	2	Specific vaccination advice at home	↑		

c) Vaccination outcomes reported narratively in included systematic reviews

Author & Year	Review quality	Number of studies	Number of studies and direction of effect: Positive direction	Negative direction	Mixed or unclear direction
Home visits used alone – vaccination outcomes					
Bright 2017	High	3	1		2
Harvey 2015	High	3	1		2
Johri 2015	High	2	2		
Munk 2019	High	2	1	1	
Lukusa 2018	High	1	1		

Author & Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Oyo-Ita 2016	High	1	1		
CPSTF 2016	Moderate	2	2		
Deardorff 2018	Moderate	1	1		
Omoniyi 2020	Moderate	1	1		
Home visits used in combination with other interventions – vaccination outcomes					
Machado 2021	High	13	12		1
Crocker-Buque 2017a	High	8	7		1
Nelson 2016	High	4	4		
Harvey 2015	High	3	3		
Gera 2016	High	2		2	
Jaca 2018	High	2	2		
Bright 2017	High	1			1
Crocker-Buque 2018	High	1			1
Jarrett 2015	High	1	1		
Kaufman 2018	High	1	1		
CPSTF 2015d	Moderate	12	11	1	
CPSTF 2015b	Moderate	7	7		
Ozawa 2018	Moderate	2	2		
Wang 2016	Moderate	2	2		
CPSTF 2015a	Moderate	1	1		
CPSTF 2016	Moderate	1	1		
Freeman 2017	Moderate	1	1		
Oliver-Williams 2017	Moderate	1			1
Watterson 2015	Moderate	1	1		

Abbreviations: CPSTF: Community Preventive Services Task Force; vs: versus.

On 16 June 2022, Racheal Kiconco, a nurse at Kamwenge District Health Centre, who also doubles as a health worker in charge of COVID-19 vaccination in Rwamwanja Refugee Settlement, Uganda engages with a lady in the queue to receive her first dose of the COVID-19 vaccine.

6. THE EFFECT OF INTERVENTIONS TARGETING HEALTHCARE WORKERS

Interventions targeting HCWs were identified from both primary studies and systematic reviews. The data from systematic reviews are presented stratified by type of intervention: HCW training and education, HCW non-material incentives, and HCW material incentives. The data from primary studies are presented together in the sections below on HCW non-material incentives and HCW material incentives.

HCW TRAINING AND EDUCATION

Nineteen systematic reviews were identified that included studies assessing HCW training and education to increase vaccination-related outcomes (Bright et al., 2017; Connors et al., 2017; CPSTF, 2015a, 2015b, 2015c, 2016; Crocker-Buque et al., 2017a, 2017b; de Cock et al., 2020; Gera et al., 2016; Jarrett et al., 2015; Machado et al., 2021; Munk et al., 2019; Nelson et al., 2016; Oliver-Williams et al., 2017; Olson et al., 2020; Omoniyi & Williams, 2020; Ozawa et al., 2018; Pal et al., 2016; Wang et al., 2016).

Intermediate outcomes

We conclude there is insufficient evidence to determine whether training HCWs can have a positive effect on caregivers' knowledge or intention to vaccinate. Our REA also found insufficient evidence that when used by itself, HCW training has a positive effect on HCW outcomes such as skills and self-efficacy (confidence talking about risks, answering difficult questions, etc.). We base these statements on the findings from five systematic reviews (*see Figure 10a*).

Vaccination outcomes

There is *sufficient evidence* (42/45 studies [93 per cent] in positive direction) that HCW training, when combined with other interventions, such as prompts for HCWs, expansion of services or caregiver education (see examples of combination interventions in *Box 3*), can have a positive effect on vaccine uptake (*see Figure 10*). We found insufficient evidence (3/3 studies in positive direction) to draw conclusions on the effectiveness of HCW training when used alone (*see Figure 10*).

Implementation considerations

Provider–caregiver communication

Connors et al. (2017) reported that when a parent is initially hesitant, participatory communication when providing a vaccine recommendation might be beneficial, as discussing the need for vaccination might build trust and develop a relationship between the provider and parent. Similarly, Nour (2019) indicated that combined interventions that sought to promote and nurture the caregiver–provider relationship could reduce the likelihood of caregivers seeking out vaccine information from unreliable sources, which can propagate vaccine misinformation. As such, the pathway may be through strong provider–caregiver relationships. Investing in motivational interviewing training for HCWs can nurture these relationships.

Connors et al. (2017) reported that participatory interventions require sufficient training to ensure physician confidence when undertaking the intervention. Additionally, providers did not elicit parental concerns and did not have a clear therapeutic relationship with the parents, which impacted the effectiveness of the intervention. Jarrett et al. (2015) found that HCW communication training may be successful for some, but not all, cases of vaccine hesitancy. HCW information training effect was poor with no clear understanding of the underlying reasons for vaccine hesitancy and the health providers' own biases.

Use of information technology in design of training could be a consideration. Oliver-Williams et al. (2017) reported multimedia learning application for HCWs (one study) improved their counselling skills. De Cock et al. (2020) noted the user-friendliness of smartphone educational applications, and the ability of apps to reduce the healthcare provider's workload when used to support Expanded Programme on Immunization coverage contributed to the successful uptake and use of information technology by HCWs.

Combination interventions

It is difficult to be prescriptive about other components that should be combined with HCW training, as studies reported a range of combinations. For example, Wang et al.'s (2016) review included studies that assessed HCW training in combination with caregiver education, material incentives for HCWs, community outreach and broader system changes. Machado et al. (2021) reported four studies that used HCW training in combination with caregiver education, home visits, material incentives for HCWs, community outreach and reminders/recall. Munk et al. (2019) examined HCW training combined with service enhancements and community collaboration, and Omoniyi and Williams (2020) described a multi-pronged approach for migrant children, including service expansion, HCW training and social mobilization for immunization.

Vaccine-hesitant populations

Three of the reviews included only studies that assessed strategies in vaccine-hesitant populations (Connors et al., 2017; Jarrett et al., 2015; Olson et al., 2020). There is insufficient evidence to determine the effectiveness of HCW training on intermediate or final vaccination outcomes; initial evidence on the impact on HCW and caregiver intermediate outcomes is mixed and on vaccine uptake is limited (2/2 studies in positive direction).

BOX 3: EXAMPLES OF COMBINATION INTERVENTIONS THAT INCLUDE HCW TRAINING AND EDUCATION

- HCWs' skills improved through training and supervision in immunization, along with introduction of community health promoters and strengthening health systems (planning, health information systems, logistics and financing).
- Screening checklist administered by HCWs to mothers at health facility, provider training and introducing policies to remove geographical barriers to vaccine access.
- Strategies assume barriers to uptake are principally on the supply side. Supportive supervision was used to enable staff to carry out their duties effectively by providing guidance. Staff training was intended to improve immunization knowledge and skill.
- Provider reminders (medical chart marked if behind on immunizations or well child visits), provider assessment and feedback based on monthly cycles, and provider education, used in tandem with client postcard reminder and recall process.

FIGURE 10:

The effect of HCW training on a) intermediate outcomes, b) meta-analyses of vaccination outcomes and c) narrative reporting of vaccination outcomes. Results are presented by whether the intervention was used alone or in combination, and whether the systematic review reported the data in a meta-analysis or narratively. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey). A green arrow pointing upwards indicates that the result of the meta-analysis was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect.

a) Intermediate outcomes reported narratively in included systematic reviews

Author Year	Review quality	Number of studies	Outcome	Number of studies and direction of effect: Positive direction	Negative direction	Mixed or unclear direction
HCW training used alone – data reported narratively						
Connors 2017	Moderate	1	HCW confidence providing information		1	
Connors 2017	Moderate	1	HCW confidence answering difficult questions		1	
Connors 2017	Moderate	1	HCW confidence talking about risks		1	
Connors 2017	Moderate	1	HCW self-efficacy			1
Olson 2020	Moderate	1	HCW skills	1		
Connors 2017	Moderate	1	Parental vaccine hesitancy			1
Olson 2020	Moderate	1	Vaccine hesitancy	1		
Connors 2017	Moderate	1	Parental resistence to recommendations		1	
Olson 2020	Moderate	1	Parental intention to vaccinate	1		
Oliver-Williams 2017	Moderate	1	Knowledge	1		
Omoniyi 2020	Moderate	1	Knowledge	1		
HCW training used in combination with other interventions – data reported narratively						
de Cock 2020	High	3	Knowledge & awareness	2	1	

b) Meta-analyses of vaccination outcomes in included systematic reviews

Author Year	Review quality	Number of studies	Analysis group	Direction of effect		
				Significant positive effect	No effect	Significant negative effect
HCW training – meta-analysis of vaccination outcomes						
Gera 2016	High	2	Cluster RCTs – measles coverage		↔	

c) Vaccination outcomes reported narratively in included systematic reviews

Author Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
HCW training used alone – vaccination outcomes					
Bright 2017	High	1	1		
Jarrett 2015	High	1	1		
Pal 2016	Moderate	1	1		
HCW training used in combination with other interventions – vaccination outcomes					
Crocker-Buque 2017a	High	4	4		
Machado 2021	High	4	4		
Gera 2016	High	3		3	
Bright 2017	High	2			2
Munk 2019	High	2	2		
Jarrett 2015	High	1	1		
Nelson 2016	High	1	1		
Wang 2016	Moderate	9	9		
Crocker-Buque 2017b	Moderate	5	5		
CPSTF 2015c	Moderate	4	4		
Omoniyi 2020	Moderate	3	3		
CPSTF 2015b	Moderate	2	2		
CPSTF 2016	Moderate	2	2		

Author Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Ozawa 2018	Moderate	2	2		
CPSTF 2015a	Moderate	1	1		
Oliver-Williams 2017	Moderate	1			1

Abbreviations: CPSTF: Community Preventive Services Task Force; RCT: randomized controlled trial.

HCW NON-MATERIAL INCENTIVES

Five systematic reviews were identified that included studies assessing HCW non-material incentives to increase vaccination-related outcomes (CPSTF, 2015b, 2015c, 2016; Machado et al., 2021; Wang et al., 2016).

Intermediate outcomes

There is insufficient evidence to determine the effectiveness of HCW non-material incentives on caregiver or HCW intermediate outcomes. We did not find any systematic reviews addressing this matter. One primary study reported that public recognition for HCWs (and caregivers) did not influence home visits. This was a moderate-quality RCT conducted in a low-income country.

Vaccination outcomes

There is *some evidence* (16/17 studies [94 per cent] in positive direction) that non-material incentives, when combined with other interventions (see examples of combination interventions in *Box 4*) can have a positive effect on vaccination uptake (*see Figure 11*). We found insufficient evidence (2/3 studies [67 per cent] in a positive direction) to determine effectiveness when this intervention was used alone. The evidence from the primary studies supports this overall bottom-line statement. We identified six studies (five RCTs, and one quasi-experimental) that evaluated non-material incentives (*see Figure 14*). Five found no evidence of effect and one had mixed results.

Implementation considerations

The non-material interventions in the studies we examined (performance feedback, employer recognition and public recognition) used incentive structures based on external and internal motivation. That is, they sought to achieve behaviour change through internal as well as external rewards. These types of incentives may be less costly than financial incentives and less prone to controversy in implementation. However, some issues need to be considered. First, if implemented as a standalone intervention project, sustaining performance after the intervention period may become an issue (Bernal & Martinez, 2020). Second, when designing performance feedback interventions, the entire team required to improve vaccination uptake should be considered. Carmichael et al. (2019) noted that non-monetary incentives combined with team-based goals had a positive impact on attitudes related to coordination and teamwork among the group of HCWs (finding not specific to vaccine uptake). Third, health system constraints such as administrative or supply chain factors impact the effectiveness of teams and their ability to achieve goals, which could result in low morale. Finally, both Wang et al. (2016) and Demilew et al., (2020) highlight the importance of providing supervision with feedback to ensure implementation and motivation.

BOX 4: EXAMPLES OF COMBINATION INTERVENTIONS THAT INCLUDE NON-MATERIAL INCENTIVES FOR HCWs

- Intensive reminder/recall at the level of the patient and as part of the well child clinic process (assessment, feedback, incentives, and exchange of information).
- A financial bonus paid to physicians based on achievement of specified immunization targets along with performance feedback (intrinsic incentive). Physicians received feedback on performance at the time of assessment and in a detailed letter afterwards. Feedback included their coverage rates, missed opportunities to immunize, comparative peer performance information, and hypothetical examples of what their coverage rates could have been if no opportunities were missed or more timely appointments were scheduled.
- Increasing immunization fees for each vaccine administered (paid up front) along with feedback were given to physicians.

FIGURE 11:

The effect of HCW non-material incentives on vaccination outcomes. Results are presented by whether the intervention was used alone or in combination. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), or mixed or unclear direction (grey).

Author Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
HCW non-material incentives used alone – vaccination outcomes					
CPSTF 2015c	Moderate	3	2	1	
HCW non-material incentives used in combination with other interventions – vaccination outcomes					
Machado 2021	High	3	3		
CPSTF 2015c	Moderate	6	5	1	
Wang 2016	Moderate	5	5		
CPSTF 2015b	Moderate	2	2		
CPSTF 2016	Moderate	1	1		

Abbreviations: CPSTF: Community Preventive Services Task Force.

HCW MATERIAL INCENTIVES

Eight systematic reviews were identified that included studies assessing HCW material incentives to increase vaccination-related outcomes (Bright et al., 2017; CPSTF, 2015a, 2015c, 2016; Crocker-Buque & Mounier-Jack, 2018; Jia et al., 2021; Machado et al., 2021; Wang et al., 2016).

Twenty primary studies assessed HCW material incentives to increase vaccination-related outcomes (Ahmed et al., 2019; Bernal & Martinez, 2020; Binyaruka et al., 2015; Carmichael et al., 2019; Cyrus et al., 2016; de Walque et al., 2021; Demilew et al., 2020; Falisse et al., 2015; Fu et al., 2016; Hu et al., 2016; Huillery & Seban, 2021; Katz et al., 2015; Khanna et al., 2021; Rajkotia et al., 2017; Salami et al., 2018; Sherry et al., 2017; Van de Poel et al., 2016; Zeng et al., 2018; Zizien et al., 2019; Zombré et al., 2020).

Intermediate outcomes

No evidence was identified from systematic reviews about the effect of HCW material incentives on intermediate outcomes.

Three primary studies considered this matter (*see Figure 13*). Two evaluated performance-based financing (PBF) and the other fee-for-service. Generally, the findings lean towards no evidence of effect on caregiver or HCW intermediate outcomes, or service quality outcomes. One high-quality cluster RCT found a significant positive effect of PBF on caregivers' satisfaction with visits to the health facility for their children under the age of 5 (not exclusive to vaccination) (de Walque et al., 2021). Ten other comparisons across the other two studies found no evidence of effect, and one found a significant negative effect on the facility's maintenance of an up-to-date immunization register.

Vaccination outcomes

There is *some evidence* (10/10 studies [100 per cent] in positive direction, plus meta-analysis of 2 studies) to support the use of material incentives for HCWs when combined with other strategies (see examples in *Box 5*), but insufficient evidence to determine use on its own (1/1 study in positive direction). One high-quality meta-analysis found a significant positive effect of bonus payments and enhanced fee-for-service paid to outpatient healthcare providers; however, only two primary studies were included in this review (Jia et al., 2021).

Findings from the primary studies are congruous with our concluding statements about the body of evidence identified from systematic reviews (*see Figure 14*). One primary study had a significant positive finding with respect to PBF versus usual care (Khanna et al., 2021). All other studies found mixed effect (positive and no effect) or no effect.

Implementation considerations

Three types of material incentives were paid to HCWs in the studies we examined: lump sum bonuses, fee-for-service, and non-monetary gifts or awards. Most studies reported these payments under performance-based financing interventions for health facilities.

Performance-based financing could be a good strategy to stimulate health providers' extrinsic motivation while simultaneously improving supply-side barriers. This will only be achieved if the intervention allows performance bonuses to be distributed among HCWs, while some proportion is retained by the facility for re-investment in equipment or supplies needed to improve the vaccination programme. The facility's procurement practice will have to be supportive of this.

With PBF, facilities are more likely to develop protocols to support goal achievement. This can create an indirect incentive to providers to increase their knowledge, which could translate into improved service quality and quantity. PBF can therefore serve the purpose of supporting HCWs' intrinsic needs.

Designing a pay for performance (P4P) initiative to increase vaccine uptake requires consideration of several factors. First, several studies noted that in areas where the immunization coverage was already high (saturation of immunization coverage), there was little room left for the intervention to have an effect. Carefully targeting the facility and the location will be important. Second, all facilities will not face the same marginal costs to achieve service improvement. The value of the incentive may have to differ from one facility to another. Third, de Walque et al. 2021, noted that the distinction between PBF and direct financing might not have been made clear enough to staff to cause them to modify their practice. Ensuring the objective of the intervention is well communicated and understood by staff will be paramount. Fourth, if P4P is being implemented across multiple services simultaneously (including childhood immunization), it is possible that providers could trade off various incentives within the P4P package. For example, Binyaruka et al. ,2015, noted that although there was no difference in the level of incentive payments for institutional deliveries in the PBF system in Tanzania, health providers perceived that service as more profitable and focussed their efforts there. PBF may be more effective for achieving vaccination outcomes if designed specifically for that purpose. Finally, achieving the ideal balance between intrinsic and extrinsic incentives when designing a P4P intervention is desirable and is perhaps an area for additional research.

On 12 December 2022, Salha, 49, a Department of Health mobile team worker, vaccinates Nada, 11, against cholera in As-Safira, south rural Aleppo, Syria.

BOX 5: EXAMPLES OF COMBINATION INTERVENTIONS THAT INCLUDE MATERIAL INCENTIVES FOR HCWS

- **Team-Based Goals and Incentives (TBGI) intervention:** HCWs were provided with training and material incentives (e.g., utensils, cookware, storage containers), and non-material rewards (certificate of recognition) when teams met their vaccination targets.
- **P4P scheme:** Financial payments made to health facilities based on achievement of targets. A proportion of the bonus is distributed among HCWs, with a percentage being retained by the facility. Staff received training and supervision.
- Intervention designed to address vaccine availability and accessibility by combining provider education and incentives (supply-side barriers) with parent education, incentives, transportation assistance and home visits.
- Quality improvement project coupled with incentive payments; commissioning of care packages in geographical areas; target-setting with deployment of information technology for reminder/recall; and follow-up of defaulters.

FIGURE 12:

The effect of HCW material incentives on vaccination outcomes from a) meta-analyses and b) studies reported narratively in included systematic reviews. Results are presented by whether the intervention was used alone or in combination. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey). A green arrow pointing upwards indicates that the result of the meta-analysis was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect.

a) Meta-analyses of vaccination outcomes from included systematic reviews

Author & Year	Review quality	Number of studies	Comparison	Direction of effect		
				Significant positive effect	No effect	Significant negative effect
HCW material incentives – meta-analysis of vaccination outcomes						
Jia 2021	High	2	Bonus, feedback and existing payments vs existing payments	↑		
		2	Enhanced FFS vs FFS	↑		

b) Studies reported narratively in included systematic reviews

Author & Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
HCW material incentives used alone – vaccination outcomes					
Bright 2017	High	1	1		
HCW material incentives used in combination with other interventions – vaccination outcomes					
Machado 2021	High	3	3		
Crocker-Buque 2018	High	1	1		
Wang 2016	Moderate	3	3		
CPSTF 2015a	Moderate	1	1		
CPSTF 2015c	Moderate	1	1		
CPSTF 2016	Moderate	1	1		

Abbreviations: CPSTF: Community Preventive Services Task Force; FFS: fee-for-service; vs: versus.

FIGURE 13:

The effect of HCWs' incentives on intermediate outcomes from primary studies. Results are presented by the type of outcome being assessed: caregiver outcomes, HCW outcomes, or service outcomes. The studies are ordered by quality (high to low) and alphabetical order. A green arrow pointing upwards indicates that the effect estimate from the study was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect.

Author & Year	Study quality	Comparison	Outcome	Direction of effect		
				Significant positive effect	No effect	Significant negative effect
Caregiver outcomes						
de Walque 2021	High	PBF vs control	Caregiver satisfaction for visits with children under age 5 (not just vaccination)	↑		
Huillery 2021	Moderate	FFS vs fixed payments	Caregiver reasons for not using child immunization services		↔	
Khanna 2021	Moderate	PBF vs DFF (randomized)	Under 5 examination, average client satisfaction score		↔	
		PBF vs DFF (randomized)	Under 5 examination, clients report that opening hours are convenient		↔	
		PBF vs control (quasi-experimental)	Under 5 examination, average client satisfaction score		↔	
		PBF vs control (quasi-experimental)	Under 5 examination, clients report that facility opening hours are convenient		↔	
HCW outcomes						
Huillery 2021	Moderate	FFS vs fixed payments	HCW motivation		↔	
		FFS vs fixed payments	HCW job satisfaction		↔	
Service outcomes						
Demilew 2020	Moderate	Public recognition for caregivers + for HCWs vs control	Number of home visits		↔	
Huillery 2021	Moderate	FFS vs fixed payments	HCW provision of immunization, prenatal care, family planning session		↔	
Khanna 2021	Moderate	PBF vs DFF (randomized)	Percentage of facilities that offered routine immunizations in the week of the survey		↔	
Khanna 2021	Moderate	PBF vs DFF (randomized)	Facilities with an up-to-date routine immunization register			↓
		PBF vs control (quasi-experimental)	Facilities with an up-to-date routine immunization register		↔	

Abbreviations: DFF: direct facility financing; FFS: fee-for-service; PBF: performance-based financing; vs: versus.

FIGURE 14:

The effect of HCWs' incentives on vaccination outcomes from primary studies. Results are presented by study design: cluster RCT or quasi-experimental, quantitative observational study. The studies are ordered by quality (high to low) and alphabetical order. A green arrow pointing upwards indicates that the effect estimate from the study was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect. Multiple arrows for one study indicate mixed results depending on analysis.

Author & Year	Study quality	Comparison	Direction of effect		
			Significant positive effect	No effect	Significant negative effect
Cluster RCTs – vaccination outcomes					
Bernal 2020	High	Post-treatment, controlling for baseline		↔	
Cyrus 2016	High	P4P vs control		↔	
de Walque 2021	High	PBF vs usual care	↑	↔	
	High	DF vs usual care		↔	
	High	Supervision/monitoring vs usual care		↔	
Fu 2016	High	P4P vs virtual quality improvement support		↔	
Carmichael 2019	Moderate	TBGI vs control		↔	
Demilew 2020	Moderate	Public recognition for caregivers + HCWs vs control		↔	
Huillery 2021	Moderate	FFS vs fixed payments		↔	
Khanna 2021	Moderate	PBF vs DFF (randomized)		↔	
Quasi-experimental or quantitative observational study – vaccination outcomes					
Ahmed 2019	High	PBF vs control		↔	
Binyaruka 2015	High	PBF vs control		↔	
Bond 2019	High	Observed vs estimated performance	↑	↔	
Falisse 2015	High	Before–after	↑	↔	↓
Sherry 2017	High	Treatment effect post-P4P		↔	
Van de Poel 2016	High	Any form of PBF districts vs control districts		↔	
Zeng 2018	High	RBF vs comparison	↑	↔	

Author & Year	Study quality	Comparison	Direction of effect		
			Significant positive effect	No effect	Significant negative effect
Zizien 2019	High	Before–after		↔	
Zombré 2020	High	PBF vs control health centres		↔	
Hu 2016	Moderate	P4P vs control	↑	↔	
Katz 2015	Moderate	Before–after		↔	
Khanna 2021	Moderate	PBF vs usual care (quasi-experimental)	↑		
Salami 2018	Moderate	RBF vs non-RBF areas	↑	↔	

Abbreviations: DF: direct financing; DFF: direct facility financing; FFS: fee-for-service; P4P: pay for performance; PBF: performance-based financing; RCTs: randomized controlled trials; RBF: results-based financing; TBGI: Team-Based Goal Initiative; vs: versus.

On 9 September 2015, children aged under 5 take part in the UNICEF-supported measles, rubella and polio vaccination campaign at Barpak Village Development Committee health post, Gorkha District, Nepal.

© UNICEF/UNI199175/PANDAY

On 23 June 2022, in Jorayal Rural Municipality in Doti District, in Nepal's remote far west, health workers Basanta Malla (left) and Tilak Raj Joshi (right) en route to a community outreach session to vaccinate children under the routine vaccination programme.

© UNICEF/UN0685535/PRASAD NGAKHUSI

7. THE EFFECT OF INTERVENTIONS TARGETING COMMUNITIES

Studies included in this section assessed interventions delivered in community settings, or to specific community groups (e.g., migrants, refugees, religious groups), to generate awareness and understanding of vaccination, promote interaction and build trust.

COMMUNITY COLLABORATION AND OUTREACH

Thirty-one systematic reviews were identified that included studies assessing community collaboration and outreach to increase vaccination-related outcomes (Abdulrahman & Olaosebikan, 2017; Bright et al., 2017; CPSTF, 2015a, 2015b, 2016; Crocker-Buque et al., 2017a, 2017b; Crocker-Buque & Mounier-Jack, 2018; Deardorff et al., 2018; Desai et al., 2020; Freeman et al., 2017; Gera et al., 2016; Hakim et al., 2019; Harvey et al., 2015; Jaca et al., 2018; Jarrett et al., 2015; Johri et al., 2015; Juni & Afiah, 2018; Lukusa et al., 2018; Machado et al., 2021; Molina et al., 2016; Munk et al., 2019; Nelson et al., 2016; Olson et al., 2020; Omoniyi & Williams, 2020; Oyo-Ita et al., 2016; Ozawa et al., 2018; Pal et al., 2016; Vedio et al., 2017; Wang et al., 2016; Watterson et al., 2015).

Intermediate outcomes

The effectiveness of community collaboration and outreach on intermediate outcomes is based on the results of four systematic reviews (Freeman et al., 2017; Hakim et al., 2019; Jarrett et al., 2015; Olson et al., 2020).

There is insufficient evidence to determine whether community collaboration or outreach used alone or in combination influences caregiver attitudes (1/1 study in positive direction), knowledge and awareness (3/3 studies in positive direction) or attitudes and beliefs (1/1 study in positive direction) (*see Figure 15*). No evidence was identified that assessed caregiver intention to vaccinate or HCW intermediate outcomes.

Vaccination outcomes

The effectiveness of community collaboration and outreach on vaccination outcomes is based on the results of 26 systematic reviews.

Four studies included meta-analyses, and although the number of included studies was limited (range 2 to 4) a significant positive effect on vaccination outcomes was reported in the main analysis of three of the four meta-analyses (*see Figure 16a*). In the study that reported no effect, a subgroup analysis of home visits that provided specific vaccination advice showed a significant positive effect (Harvey et al., 2015).

There is *sufficient evidence* that community collaboration or outreach used alone has a positive effect on vaccination outcomes (*see Figure 16*). Of the 13 reviews reporting these data, a positive effect on vaccination outcomes was reported in 26/26 of the included studies.

There is *sufficient evidence* that community collaboration or outreach in combination (see examples in *Box 6*) with other interventions improves vaccination outcomes (*see Figure 16*). Across the 18 reviews that assessed this intervention type, 75/76 of the included studies (99 per cent) reported a positive direction of effect on vaccination outcomes.

BOX 6: EXAMPLES OF COMBINATION INTERVENTIONS THAT INCLUDE COMMUNITY COLLABORATION/OUTREACH

- A community–provider partnership focussed on provider knowledge and accountability, practice and system improvements, and community outreach.
- Community-based outreach and tracking including health and immunization education, immunization reminders, follow-up cards/phone calls/home visits and feedback and incentives.
- Assessment, referral, monthly voucher pick-up, outreach/tracking and parental incentives.
- Community leaders who supported community mobilization, film shown to whole community: 'edutainment' drama, presentation, computer simulation of virus, feedback.
- HCW training, health systems improvements, family and community activities.

Implementation considerations – community collaboration and outreach

There were limited data identified on intermediate outcomes, therefore the pathway to vaccination uptake is unclear. However, the study authors attribute the effectiveness of community collaboration and outreach interventions to their multidimensionality, being contextually specific and being able to leverage pre-existing relationships and delivery structures (Bright et al., 2017; Crocker-Buque et al., 2017a; Freeman et al., 2017; Machado et al., 2021; Omoniyi & Williams, 2020; Wang et al., 2016).

Community interventions are multidimensional in nature as they may address information or service requirements but do so in a local environment. Reducing the distance between services and the community may improve vaccination outcomes by addressing many barriers, including geographical, financial and accessibility barriers (Bright et al., 2017; Crocker-Buque et al., 2017b). Access barriers may be particularly important in low socio-economic status populations and populations in remote areas (Machado et al., 2021; Wang et al., 2016).

Interventions targeting the community may also be successful because they address contextual factors of the local community and tackle the underlying determinants of health behaviour. Jarrett et al. (2015) found that involvement of community leaders and social mobilization were effective as they aim to understand the target audience, facilitate dialogue and integrate activities. Wang et al. (2016) also highlighted the importance of considering local customs and cultural taboos in the development of community services.

Collaboration with community members in implementation and evaluation enables the vast local knowledge they have to be disseminated to and used by health staff (Freeman et al., 2017). Partnerships with community-based organizations to coordinate vaccination activities may be beneficial as they utilize pre-existing service delivery structures and harness pre-established relationships with parents (Machado et al., 2021). Involving community members may also increase acceptability of services (Bright et al., 2017). In particular, involvement of trusted local leaders as vaccination advocates may increase acceptance and counteract disinformation (Omoniyi & Williams, 2020).

Local context is key to the success of community-targeted interventions. Molina et al. (2016) reported that community participation may be hampered if there are differences in the community, particularly ethnic fractionalization, but also income inequality. Desai et al. (2020) identified four barriers to effective functioning of community groups, including migration; poor supply of supporting health services, including vaccinations; irregular attendance by group members; and group dissolution. Involvement of community members in planning and evaluation may also need objective data on performance to stimulate participation and engagement (Molina et al., 2016).

Vaccine-hesitant populations and community collaboration and outreach

One of the reviews included only studies that assessed strategies in vaccine-hesitant populations (Jarrett et al., 2015). There is insufficient evidence to determine the effectiveness of interventions that include a community component on intermediate or final vaccination outcomes in vaccine-hesitant populations. However, Jarrett et al. (2015) suggest that an important component for the success of these interventions (e.g., targeting community leaders and social mobilization) may be that they aim to understand the target audience and facilitate dialogue.

FIGURE 15:

The effect of community collaboration and outreach on intermediate outcomes. Results are presented by whether the intervention was used alone or in combination. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey).

Author Year	Review quality	Number of studies	Outcome	Number of studies and direction of effect		
				Positive direction	Negative direction	Mixed or unclear direction
Community collaboration or outreach used alone – data reported narratively						
Jarrett 2015	High	1	Caregiver knowledge	1		
Jarrett 2015	High	1	Vaccination awareness	1		
Freeman 2017	Moderate	1	Community awareness	1		
Olson 2020	Moderate	2	Caregiver attitudes	2		
Community collaboration or outreach used in combination with other interventions – data reported narratively						
Hakim 2019	High	1	Caregiver knowledge			1
Hakim 2019	High	1	Caregiver attitudes and beliefs	1		

FIGURE 16:

The effect of community collaboration and outreach on vaccination outcomes reported a) as meta-analyses and b) narratively in the included systematic reviews. Results are presented by whether the intervention was used alone or in combination. The studies are ordered by quality (high to low), number of studies included (high to low), and alphabetical order. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey). A green arrow pointing upwards indicates that the result of the meta-analysis was significant and positive, a grey arrow pointing left and right indicates no effect, and a red arrow pointing downwards indicates a statistically negative effect.

a) Meta-analyses from included systematic reviews

Author & Year	Review quality	Number of studies	Outcome	Direction of effect		
				Significant positive effect	No effect	Significant negative effect
Community collaboration or outreach – meta-analysis of vaccination outcomes						
Harvey 2015	High	4	Overall – LHW home visit vs control		↔	
Harvey 2015	High	2	Specific vaccination advice at home	↑		
Lukusa 2018	High	3	Caregiver education in the community or home	↑		
Molina 2016	High	2	Short-term impact	↑		
Oyo-Ita 2016	High	2	Health education in the community vs usual care	↑		

b) Studies reported narratively in included systematic reviews

Author & Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Community collaboration or outreach used alone – vaccination outcomes					
Bright 2017	High	4	2		2
Harvey 2015	High	4	4		
Jarrett 2015	High	4	4		
Munk 2019	High	3	3		
Desai 2020	High	2	1		1
Johri 2015	High	2	2		
Molina 2016	High	1	1		
Oyo-Ita 2016	High	1	1		
Omoniyi 2020	Moderate	3	3		
Crocker-Buque 2017b	Moderate	2	2		

Author & Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Deardorff 2018	Moderate	1	1		
Pal 2016	Moderate	1	1		
Abdulrahman 2017	Low	1	1		
Community collaboration or outreach combined with other interventions – vaccination outcomes					
Machado 2021	High	11	11		
Crocker-Buque 2017a	High	9	9		
Bright 2017	High	5	1		4
Jarrett 2015	High	3	3		
Nelson 2016	High	3	3		
Crocker-Buque 2018	High	1			1
Gera 2016	High	1		1	
Jaca 2018	High	1	1		
Oyo-Ita 2016	High	1	1		
Freeman 2017	Moderate	13	13		
Wang 2016	Moderate	8	8		
Ozawa 2018	Moderate	6	6		
CPSTF 2016	Moderate	5	5		
CPSTF 2015b	Moderate	5	5		
Crocker-Buque 2017b	Moderate	3	3		
CPSTF 2015a	Moderate	1	1		
Deardorff 2018	Moderate	1	1		
Juni 2018	Moderate	1	1		
Omoniyi 2020	Moderate	1	1		
Watterson 2015	Moderate	1	1		
Vedio 2017	Low	1	1		

Abbreviations: vs: versus.

THE EFFECT OF INTERVENTIONS TARGETING COMMUNITY SUBGROUPS

Faith-based community outreach

Four systematic reviews were identified that included studies assessing faith-based community collaboration and outreach to increase vaccination-related outcomes (Deardorff et al., 2018; Jarrett et al., 2015; Omoniyi & Williams, 2020; Wang et al., 2016).

Intermediate outcomes

The effectiveness of faith-based community collaboration and outreach on intermediate outcomes is based on the results of one study identified by one systematic review (positive direction of effect). Therefore, there is insufficient evidence to determine whether outreach to faith-based communities used alone or in combination influences caregiver knowledge (*see Figure 17a*). No evidence was identified that assessed caregiver attitudes or intention to vaccinate or HCW intermediate outcomes.

Vaccination outcomes

The effectiveness of faith-based community collaboration and outreach on vaccination outcomes is based on the results of four systematic reviews (*see Figure 17b*).

Overall, there is insufficient evidence that collaboration with and outreach to faith-based communities has a positive effect on vaccination outcomes either alone (1/1 study, positive direction) or in combination (9/9 studies in positive direction; see examples of combination interventions in *Box 7*).

Implementation considerations – outreach and collaboration with faith-based communities

The limited data found on faith-based community outreach is positive. Involvement of religious and traditional leaders may be an effective strategy as effort is taken to understand the target audience and facilitate dialogue (Jarrett et al., 2015). Religious leaders may also be able to help in adapting services to local customs and identifying cultural taboos (Wang et al., 2016).

BOX 7: EXAMPLES OF COMBINATION INTERVENTIONS THAT INCLUDE FAITH-BASED COMMUNITY OUTREACH

- Education to HCWs and local people, vaccinators in rural areas register and educate pregnant women and family, educational films during religious congregations.
- Monthly assessment of health departments, education by village doctors and religious leaders, reporting by village doctors and supervision.
- Volunteers picked from across the village, including religious groups, to identify barriers in the community, develop action plan with community, and hold meetings to educate mothers, heads of households, and leaders.
- Booths with festive atmosphere, booklets, pamphlets, posters, face-to-face information at booths to encourage immunization for pilgrimage to Hajj.
- Community leaders (political, traditional, religious) support community mobilization. Film shown to whole community: ‘edutainment’ drama, presentation, computer simulation of virus, feedback. Event began with prayer.

FIGURE 17:

The effect of faith-based community outreach on a) intermediate outcomes and b) vaccination outcomes. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey).

a) Intermediate outcomes reported narratively in included systematic reviews

Author Year	Review quality	Number of studies	Outcome	Number of studies and direction of effect		
				Positive direction	Negative direction	Mixed or unclear direction
Faith-based community outreach used in combination with other interventions – data reported narratively						
Jarrett 2015	High	1	Knowledge	1		

b) Vaccination outcomes reported narratively in included systematic reviews

Author Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Faith-based community outreach used alone – vaccination outcomes					
Omoniyi 2020	Moderate	1	1		
Faith-based community outreach combined with other interventions – vaccination outcomes					
Jarrett 2015	High	3	3		
Wang 2016	Moderate	5	5		
Deardorff 2018	Moderate	1	1		

Populations on the move

Systematic reviews that included studies assessing migrant populations, refugees or other populations on the move are summarized here. No evidence was found on the effectiveness of outreach to populations on the move on intermediate outcomes such as knowledge, attitudes, beliefs or intentions. Two systematic reviews included studies assessing the effect of interventions targeting populations on the move on vaccination outcomes (*see Figure 18* and *Box 8*) (Hui et al., 2018; Omoniyi & Williams, 2020). There is insufficient evidence (2/2 studies in positive direction) to determine the effectiveness of interventions targeting populations on the move.

BOX 8: EXAMPLES OF COMBINATION INTERVENTIONS THAT INCLUDE OUTREACH TO POPULATIONS ON THE MOVE

- Vaccination day held monthly for Roma children and women of childbearing age. This outreach was one of several public health interventions implemented in the nomad camps as part of the tuberculosis outbreak assessment programme, following notification of a case of TB in the Camp of Via Salaria.
- A multi-pronged approach targeting migrant children included expanding the immunization programme schedule; training HCWs; introducing a screening tool to identify immunization needs among clinic attendants; creating and implementing a support group for social mobilization within the community.

FIGURE 18:

The effect of interventions targeting populations on the move on vaccination outcomes. Bars provide a visual representation of the data on a scale of 1–13 (13 was the highest number of studies included in a review that showed an effect in one direction; all figures have been scaled to this range, allowing figures to be compared). Effect sizes are measured as positive direction (green), negative direction (orange), and mixed or unclear direction (grey).

Author Year	Review quality	Number of studies	Number of studies and direction of effect		
			Positive direction	Negative direction	Mixed or unclear direction
Outreach to populations on the move in combination with other interventions					
Hui 2018	High	1	1		
Omoniyi 2020	Moderate	1	1		

On 14 March, 2012, vials of vaccine are ready to be administered to malnurished children, at the Health Reference Center of the Circle of Mopti, Mali.

© UNICEF/UNI122977/DICKO

8. EVIDENCE GAPS

OVERVIEW OF EVIDENCE GAPS

Several EGMs illustrate the distribution of studies with evidence on: the effects of interventions on caregiver intermediate outcomes (*see Figure 19*); HCW intermediate outcomes (*see Figure 20*); community intermediate outcomes (*see Figure 21*); and final vaccination outcomes (*see Figure 22*). On each EGM, the vertical columns display the interventions, and the horizontal rows display the outcomes. The cells show the number of studies for each intervention–outcome combination.

Most reviews assessing the impact of interventions on caregiver intermediate outcomes were high quality and assessed knowledge, attitudes and intention to vaccinate. We did not identify any reviews that examined interventions for altering caregiver belief systems.

There are no high-quality systematic reviews assessing HCW or community intermediate outcomes. Significant evidence gaps exist in evidence pertaining to HCW attitudes towards vaccination, and about interventions that could positively impact their motivation to deliver vaccination or to recommend it to caregivers. Similarly, we found no evidence from systematic reviews about strategies that could systematically affect community-wide beliefs and norms. The available evidence on community awareness outcomes is limited.

We identified many reviews assessing the effect of interventions on final vaccine outcomes. The measures of vaccine uptake varied between reviews. Most reviews assessing interventions to improve vaccination timeliness, up-to-date vaccination (UTD), vaccination completion, coverage, or the measures of vaccine acceptance (uptake) were high quality. We did not find any systematic reviews assessing interventions to achieve initiation of the vaccine course.

There were also evidence gaps in terms of data from Eastern Europe and Central Asia (*see Figure 3* and *Figure 5*), evidence on populations of concern (migrant, refugee and transient populations) and evidence on the essential components of multicomponent interventions.

EFFECT OF EVIDENCE GAPS ON OUR CONCEPTUAL FRAMEWORK

Reflecting on our conceptual framework (presented in Section 2), we did not find evidence to establish several of the hypothesized links. Specifically: (1) links between HCWs' knowledge, skills, attitudes and beliefs, and HCW motivation to vaccinate; (2) caregiver's intention to vaccinate and HCWs' motivation to vaccinate (or to recommend vaccination) (no studies reported on this latter outcome); (3) HCW intermediate outcomes (knowledge, skills, attitudes and beliefs) and vaccination service quality, or service quality and caregivers' service experience or intention to vaccinate; (4) social and community norms and caregivers' intention to vaccinate. Although several reviews reported on the effect of interventions on several intermediate and final outcomes, the studies did not unpack all the mechanisms of change as illustrated in the framework.

FIGURE 19:

EGM illustrating the number of systematic reviews identified by the REA for caregiver intermediate outcomes (rows) stratified by class of intervention (columns). High-quality reviews are shaded green, moderate-quality reviews are shaded blue, and low-quality reviews are shaded orange.

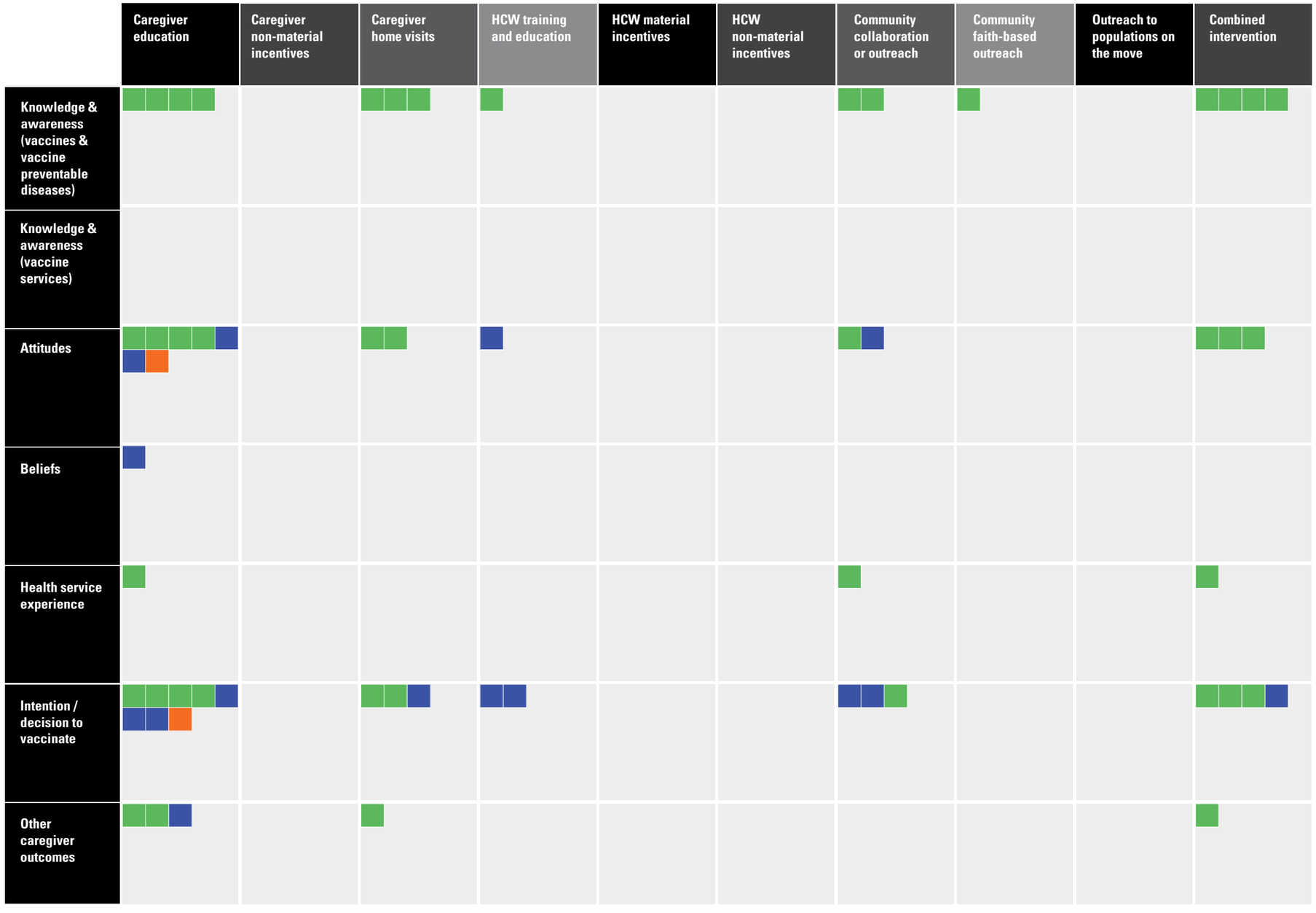


FIGURE 20:

EGM illustrating the number of systematic reviews identified by the REA for HCW intermediate outcomes (rows) stratified by class of intervention (columns). High-quality reviews are shaded green, moderate-quality reviews are shaded blue, and low-quality reviews are shaded orange.

FIGURE 21:

EGM illustrating the number of systematic reviews identified by the REA for community intermediate outcomes (rows) stratified by class of intervention (columns). High-quality reviews are shaded green, moderate-quality reviews are shaded blue, and low-quality reviews are shaded orange.

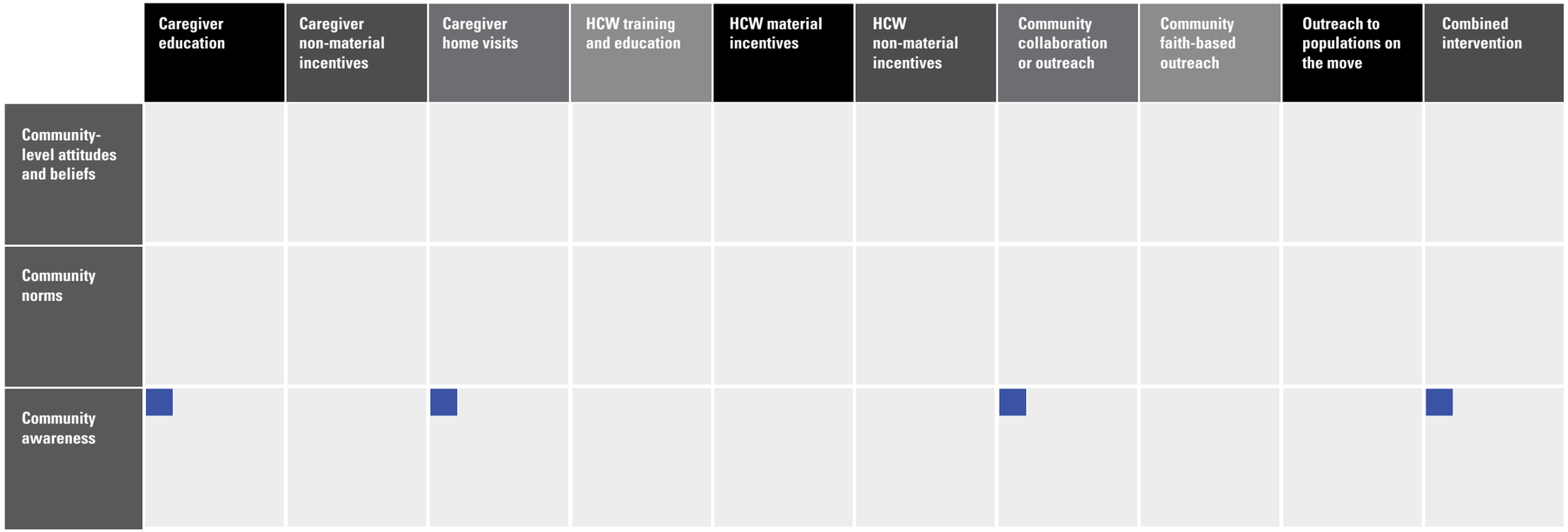


FIGURE 22:

EGM illustrating the number of systematic reviews identified by the REA for vaccination outcomes (rows) stratified by class of intervention (columns). High-quality reviews are shaded green, moderate-quality reviews are shaded blue, and low-quality reviews are shaded orange.

Abbreviations: UTD: up-to-date vaccination.

On 9 February 2019, a mobile vaccination team gathers in Aden, Yemen, during a UNICEF-supported measles and rubella vaccination campaign.

9. IMPLICATIONS FOR RESEARCH

The REA identified a large body of research on vaccine uptake in children. However, we also identified gaps in the evidence published from 2015 onwards. Here we highlight several areas for future research studies.

No studies included in the reviews analysed behavioural interventions designed to change HCW vaccination attitudes and how these interventions could impact HCW motivation to deliver vaccination or to recommend it to caregivers. A few well-conducted primary studies examined how material and non-material incentives could alter performance and ultimately change vaccine uptake. However, these studies did not explore the underlying behaviour change mechanisms of these interventions. This could be built into future studies.

We found no evidence from systematic reviews about the effect of caregiver or HCW interventions on health service experience. Rigorous studies are required to evaluate how interventions for caregivers or HCW can affect vaccination-related service quality and experience.

We found no evidence from systematic reviews about strategies to alter community-wide beliefs and norms. Trials or rigorous evaluations of interventions delivered at the community level, and their effects on social or community norms, should be conducted. To provide a full understanding, studies should not rely only on qualitative or descriptive norms but should attempt to find proxy measures of norms that could be comparable across studies.

We found limited studies assessing the characteristics of effective community interventions, although this evidence gap has since been tackled in a systematic review published after the search date for this REA (Jain et al., 2022). The review found that interventions that involved community buy-in or development of new community-based structures had a consistent positive effect on vaccination outcomes. Additional primary research is needed on the effect of community interventions on intermediate outcomes to understand the causal chain.

We did not identify any systematic reviews focussing on interventions utilizing social media and online communities as a method to disseminate information to caregivers and communities. These online platforms provide an opportunity to deliver information to many people and fill information gaps that caregivers have in a more informal way than during health facility visits or home visits. Evidence synthesis will be important to understand the utility of these interventions to alter vaccination behaviours.

There were a limited number of studies identified that were undertaken in European and Central Asian countries. Studies are needed in this region to understand how these interventions may work to meet the needs of these communities and target the barriers to vaccination in this region.

On 11 Jan 2021, Pakistan launched its first national campaign of the year, aiming to vaccinate over 40 million children under five years of age against polio and provide vitamin A supplementation.

© UNICEF/UN0399487/BUKHARI

10. IMPLICATIONS FOR PRACTICE

The following section considers the implications of the research identified in the REA on practice. Each intervention category is discussed separately, both in general and in relation to the determinants of low vaccine uptake in Europe and Central Asia.

INTERVENTIONS TARGETING CAREGIVERS

Delivery of *information or education* to caregivers was found to have a positive effect on caregiver attitudes and vaccination uptake. Implementation of this type of intervention may be most effective when baseline levels of education are low or where knowledge is the main barrier to vaccination rather than hesitancy. Health promotion materials should address knowledge deficits specific to the population using materials that are not complex and are culturally and linguistically appropriate. There is evidence that discussion rather than written education may be important for effectiveness, but since discussion/dialogue-based interventions may be costly and time-consuming, implementation may need to be targeted rather than universal.

In some European and Central Asian countries, caregiver knowledge and awareness was reported as a barrier to vaccination (Burnett et al., 2018). Therefore, education activities in Europe and Central Asia could target these populations. Identifying trusted messengers to deliver vaccination information may also be important to effectiveness. In some European and Central Asian countries, there is mistrust between caregivers, HCWs and the government; therefore, consideration needs to be given to who will deliver the information.

Home visits (typically used to educate and to administer vaccines) were found to be effective at improving vaccination outcomes. Home visits (and some community outreach interventions) bring services closer to those who need them and may be useful in remote areas, in disadvantaged groups and in low socio-economic populations.

In Europe and Central Asia, Burnett et al. (2018) reported that access to health services is a barrier to vaccination in displaced migrant groups and ethnic populations. We did not identify any studies assessing home visits in this population, but home visits could potentially address this barrier.

No studies were identified that assessed the impact of *caregiver non-material incentives* on vaccination uptake; therefore, a monitoring and evaluation plan will need to be carefully designed to understand the effectiveness of this intervention should it be implemented.

INTERVENTIONS TARGETING HCWS

Training HCWs combined with other interventions was found to have a positive effect on vaccination outcomes. Improving provider–patient communication was the focus of training in the few studies that provided details about training objectives. Training and educating health providers could, however, be regarded as a cross-cutting intervention to support provider, caregiver and community members' behaviour change objectives, and to attain health system strengthening.

In Europe and Central Asia, caregivers perceived that HCWs lacked knowledge, and were vaccine-hesitant (Burnett et al., 2018). We found insufficient evidence to determine the effect of HCW training on intermediate vaccination outcomes, and so it is unclear if HCW training and education would improve caregiver perceptions.

Based on the research identified in this REA, there is no evidence to suggest that *material incentives for HCWs* can positively impact intermediate behavioural outcomes of HCWs, caregivers or the community. However, there is evidence that this intervention is effective at improving vaccine uptake when the strategy is used in combination with other interventions. If decision-makers wish to incentivize the delivery of vaccination services, P4P or FFS are both promising approaches.

Non-material incentives, in the form of performance feedback, enhanced supervision and monitoring, and recognition, were also found to be effective at increasing vaccination uptake, when these interventions were combined with other interventions. Policymakers should keep in mind that there is a natural link between training, feedback, performance and reward, and should develop interventions for HCWs that treat these aspects in a holistic manner.

INTERVENTIONS TARGETING COMMUNITIES

The content of *community-based interventions* to improve childhood vaccination uptake was varied, and could be delivered in many settings, and by a range of people including parents, religious leaders or lay community workers. Providing community-based interventions as a single strategy or in combination has a positive effect on vaccination outcomes.

This could be a useful approach in Europe and Central Asia where mistrust among caregivers, HCWs and the government may represent a barrier to vaccination (Burnett et al., 2018). Collaboration with community leaders and involving trusted community organizations in coordination of vaccination activities may be beneficial as it harnesses pre-established relationships. Community members also have local knowledge that can be leveraged to adapt interventions to meet community needs. In addition, Omoniyi and Williams (2020) observed that in some settings, community leaders enjoy legitimacy that political leaders do not. We found one review that examined interventions to increase vaccination uptake which showed that monthly vaccination days at a nomadic Roma camp in Italy resulted in an increase in coverage (Hui et al., 2018).

COMBINATION INTERVENTIONS

Multicomponent interventions were regularly highlighted as being effective in many of the included systematic reviews. This is likely because barriers to vaccination are multidimensional; therefore, having multiple components allows several determinants of low vaccine uptake to be tackled simultaneously. The components of successful combination interventions used across the reviews were varied and therefore we were unable to identify consistently successful combination interventions. In addition, variability in settings and populations in the included studies means that a successful intervention in one study may not be as successful in another context if the barriers to vaccine uptake are different. Therefore, interventions need to be selected based on the contextual factors of the local population and be specific to addressing their barriers.

Additional considerations

In addition to the effectiveness of the interventions explored in the REA, policymakers may need to consider other factors not explored in this review, including (1) costs and cost-effectiveness; (2) assimilation (e.g., it may be easier to integrate vaccination home visiting into primary care maternal and child health than to incorporate an FFS initiative into a tax-funded health system where providers are paid a salary); and (3) sustainability. Additionally, the order that interventions are implemented may be important; for example, if system improvements are needed, these may need to be addressed before HCW training or caregiver communication interventions are carried out.

On 22 September 2020, a girl receives the polio vaccine in Rawalpindi, Pakistan.

11. LIMITATIONS

We aimed to be as comprehensive as possible when conducting this review; however, due to the nature of RAEs, there are limitations to the methodologies we used when compared with a systematic review (Bakrania, 2020).

Screening, data extraction and quality appraisal were done by single reviewers, which is more prone to errors when compared with double reviewing. Some included systematic reviews had overlapping research questions. This means that some primary studies were included in several systematic reviews and are counted multiple times in this REA. In addition, we applied a publication year limit (2015 onwards), which was a pragmatic decision due to the volume of literature identified. The data presented here are a subset of the total body of global evidence, and it is possible that studies not included in our REA may have impacted the strength of the recommendations.

We used 'vote counting' for our data synthesis approach, which has limitations when summarizing results as it does not account for the size of the effect. However, some reviews only reported direction of effect (positive, no effect, negative); therefore, we chose this methodology to utilize all the evidence from the included studies and to assess the full range of interventions and outcomes. In addition, it is a recommended approach by the Cochrane Collaboration (McKenzie, 2022). The standardized effectiveness statements were adapted from another review, which enabled us to use consistent language to describe the results (Ryan et al., 2014). We also visualized the results of the vote counting method to assist with interpretation.

The REA is reliant on the information extracted by the included systematic reviews, which may not be complete. There may also be methodological limitations at review level, study level or both that affect the interpretation of results, especially where we identified limited evidence.

This REA did not assess systems-level interventions such as changes to cold chain infrastructure, vaccination guidelines, health system financing or vaccine supply. We recognize that these factors are important and can limit the effectiveness of interventions designed to improve demand. Therefore, the robustness of the health system also needs to be considered alongside the recommendations made in this REA.

On 22 February 2015, a large group of parents with their children, and siblings with their younger siblings, gather at the polio booth to get every child under the age of 5 years vaccinated against polio, on 'Polio Day', Badam Nagar, Jamalpur, India.

12. CONCLUSION

This REA aimed to understand the effectiveness of interventions targeting caregivers, HCWs and the community on intermediate vaccination outcomes and vaccination rates of children ≤5 years old. The review identified a large body of research, but we identified limited evidence on the effectiveness of these interventions on intermediate outcomes such as intention and motivation. For vaccination outcomes, we identified *some or sufficient evidence* on the effectiveness for several interventions, including caregiver education alone or in combination with other interventions; home visits alone or in combination; HCW training in combination; HCW material and non-material incentives used in combination; and community outreach and collaboration, both alone and in combination. Multicomponent interventions were found to be consistently effective. Selection of interventions should be tailored to the needs and barriers of the local population.

REFERENCES

Abdulrahman, S. A., & Olaosebikan, M. O. (2017). mHealth: a narrative synthesis of evidence of its application in improving childhood immunization coverage. *Journal of Hospital Management and Health Policy, 1*(4). https://jhmhp.amegroups.com/article/view/3946

Ahmed, T., Arur, A., de Walque D., & Shapira, G. (2019). *Incentivizing quantity and quality of care: evidence from an impact evaluation of performance-based financing in the health sector in Tajikistan*. Policy Research Working Paper, No. 8951. Washington, DC: World Bank.

Akojie, H. (2021). *Strategies for teaching new mothers the importance of vaccination.* https://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2020-79976-040&site=ehost-live

Bakrania, S. (2020). Methodological briefs on evidence synthesis: brief 2: introduction. *Innocenti Research Briefs*, no. 2020-02, UNICEF Office of Research – Innocenti, Florence. https://www.unicef-irc.org/publications/1078-methodological-briefs-on-evidence-synthesis-brief-2-introduction.html

Baptista, L. M. S. F. (2018). *Strategies to improve MMR vaccine coverage in developed countries: a systematic review.* https://estudogeral.sib.uc.pt/handle/10316/82524?mode=full

Bernal, P., & Martinez, S. (2020). In-kind incentives and health worker performance: experimental evidence from El Salvador. *Journal of Health Economics, 70*, 102267. https://doi.org/10.1016/j.jhealeco.2019.102267

Binyaruka, P., Patouillard, E., Powell-Jackson, T., Greco, G., Maestad, O., & Borghi, J. (2015). Effect of paying for performance on utilisation, quality, and user costs of health services in Tanzania: a controlled before and after study. *PLoS One, 10*(8), e0135013. https://doi.org/10.1371/journal.pone.0135013

Bond, A. M., Volpp, K. G., Emanuel, E. J., Caldarella, K., Hodlofski, A., Sacks, L., Patel, P., Sokol, K., Vittore, S., Calgano, D., Nelson, C., Weng, K., Troxel, A., & Navathe, A. (2019). Real-time feedback in pay-for-performance: does more information lead to improvement? *Journal of General Internal Medicine, 34*(9), 1737–1743. https://doi.org/10.1007/s11606-019-05004-8

Brewer, N. T., & Fazekas, K. I. (2007). Predictors of HPV vaccine acceptability: a theory-informed, systematic review. *Preventive Medicine, 45*(2–3), 107–114. https://doi.org/10.1016/j.ypmed.2007.05.013

Bright, T., Felix, L., Kuper, H., & Polack, S. (2017). A systematic review of strategies to increase access to health services among children in low and middle income countries. *BMC Health Services Research, 17*(1), 252. https://doi.org/10.1186/s12913-017-2180-9

Bruel, S., Leclercq, T., Ginzarly, M., Botelho-Nevers, E., Frappé, P., & Gagneux-Brunon, A. (2020). Patient decision aid in vaccination: a systematic review of the literature. *Expert Review of Vaccines, 19*(4), 305–311. https://doi.org/10.1080/14760584.2020.1742111

Burnett, A., Mosquera Vasques, M., Tomsa, S., & Stefanet, S. (2018). Immunisation and vaccine hesitancy in Europe and Central Asia: a systematic review of literature (2008-2017) and field visits to Bosnia and Herzegovina, Republic of Moldova, Romania and Ukraine. UNICEF Regional Office for Europe and Central Asia.

Carmichael, S. L., Mehta, K., Raheel, H., Srikantiah, S., Chaudhuri, I., Trehan, S., Mohanty, S., Borkum, E., Mahapatra, T., Weng, Y., Kaimal, R., Sivasankaran, A., Sridharan, S., Rotz, D., Tarigopula Usha, K., Bhattacharya, D., Atmavilas, Y., Munar, W., Rangarajan, A., & Darmstadt, G. L. (2019). Effects of team-based goals and non-monetary incentives on front-line health worker performance and maternal health behaviours: a cluster randomised controlled trial in Bihar, India. *BMJ Global Health, 4*(4), e001146. https://doi.org/10.1136/bmjgh-2018-001146

Centers for Disease Control and Prevention. (2022). *The guide to community preventive services (The Community Guide).* https://www.thecommunityguide.org/

Connors, J. T., Slotwinski, K. L., & Hodges, E. A. (2017). Provider-parent communication when discussing vaccines: a systematic review. *Journal of Pediatric Nursing, 33*, 10–15. https://doi.org/10.1016/j.pedn.2016.11.002

CPSTF. (2015a). Vaccination programs: client or family incentive rewards. *Community Preventive Services Task Force.* https://www.thecommunityguide.org/findings/vaccination-programs-client-or-family-incentive-rewards

CPSTF. (2015b). Vaccination programs: client reminder and recall systems. *Community Preventive Services Task Force.* https://www.thecommunityguide.org/findings/vaccination-programs-client-reminder-and-recall-systems

CPSTF. (2015c). Vaccination programs: provider assessment and feedback. *Community Preventive Services Task Force.* https://www.thecommunityguide.org/findings/vaccination-programs-provider-assessment-and-feedback

CPSTF. (2015d). Vaccination programs: special supplemental nutrition program for women, infants & children (WIC) settings. *Community Preventive Services Task Force.* https://www.thecommunityguide.org/findings/vaccination-programs-special-supplemental-nutrition-program-women-infants-children-wic

CPSTF. (2016). Vaccination programs: home visits to increase vaccination rates. *Community Preventive Services Task Force.* https://www.thecommunityguide.org/findings/vaccination-programs-home-visits-increase-vaccination-rates.html

Crocker-Buque, T., Edelstein, M., & Mounier-Jack, S. (2017a). Interventions to reduce inequalities in vaccine uptake in children and adolescents aged < 19 years: a systematic review. *Journal of Epidemiology and Community Health, 71*(1), 87–97. https://doi.org/10.1136/jech-2016-207572

Crocker-Buque, T., Mindra, G., Duncan, R., & Mounier-Jack, S. (2017b). Immunization, urbanization and slums – a systematic review of factors and interventions. *BMC Public Health, 17*(1), 556. https://doi.org/10.1186/s12889-017-4473-7

Crocker-Buque, T., & Mounier-Jack, S. (2018). Vaccination in England: a review of why business as usual is not enough to maintain coverage. *BMC Public Health, 18*, 15. https://doi.org/10.1186/s12889-018-6228-5

Cyrus, Y. E., Elina, D., Anubhav, A., Arunika, A., Olakunle, A., Anbrasi, E., Shivam, G., Holly, B. S., Gilbert, B., & David, H. P. (2016). Effectiveness of a pay-for-performance intervention to improve maternal and child health services in Afghanistan: a cluster-randomized trial. *International Journal of Epidemiology, 45*(2), 451–459. https://doi.org/10.1093/ije/dyv362

de Cock, C., van Velthoven, M., Milne-Ives, M., Mooney, M., & Meinert, E. (2020). Use of apps to promote childhood vaccination: systematic review. *JMIR mHealth and uHealth, 8*(5), e17371. https://doi.org/10.2196/17371

de Walque, D., Robyn, P. J., Saidou, H., Sorgho, G., & Steenland, M. (2021). Looking into the performance-based financing black box: evidence from an impact evaluation in the health sector in Cameroon. *Health Policy and Planning*. https://doi.org/10.1093/heapol/czab002

Deardorff, K. V., Means, A. R., Asbjornsdottir, K. H., & Walson, J. (2018). Strategies to improve treatment coverage in community-based public health programs: a systematic review of the literature. *PLOS Neglected Tropical Diseases, 12*(2), 20. https://doi.org/10.1371/journal.pntd.0006211

Demilew, A., Girma, M., McElwee, E., Datta, S., Barofsky, J. and Disasa, T., 2021. Impacts of supportive feedback and nonmonetary incentives on child immunisation in Ethiopia, 3ie Grantee Final Report. New Delhi: International Initiative for Impact Evaluation. https://www.3ieimpact.org/sites/default/files/2021-03/GFR-TW10.1125-Ethiopia-Incentives.pdf

Demilew, A., Mesay, G., McElwee, E., Datta, S., Barofsky, J., & Disasa, T. (2020). *Improving immunisation through supportive feedback and nonmonetary incentives: impact evaluation in Ethiopia*.

Desai, S., Misra, M., Das, A., Jyoti Singh, R., Sehgal, M., Gram, L., Kumar, N., & Prost, A. (2020). Community interventions with women's groups to improve women's and children's health in India: a mixed-methods systematic review of effects, enablers and barriers. *BMJ Global Health, 5*(12). https://doi.org/10.1136/bmjgh-2020-003304

Engelbert, M., Jain, M., Bagai, A., Berkovics, B., Atika, D., & Parsekar, S. (2021). *Interventions to improve childhood immunisation and related outcomes in low- and middle-income countries: an evidence gap map*. International Initiative for Impact Evaluation (3ie). https://gapmaps.3ieimpact.org/node/36992/about

Falisse, J.-B., Ndayishimiye, J., Kamenyero, V., & Bossuyt, M. (2015). Performance-based financing in the context of selective free health-care: an evaluation of its effects on the use of primary health-care services in Burundi using routine data. *Health Policy and Planning, 30*(10), 1251–1260. https://doi.org/10.1093/heapol/czu132

Freeman, P. A., Schleiff, M., Sacks, E., Rassekh, B. M., Gupta, S., & Perry, H. B. (2017). Comprehensive review of the evidence regarding the effectiveness of community-based primary health care in improving maternal, neonatal and child health: 4. child health findings. *Journal of Global Health, 7*(1), 010904. https://doi.org/10.7189/jogh.07.010904

Fu, L. Y., Zook, K., Gingold, J. A., Gillespie, C. W., Briccetti, C., Cora-Bramble, D., Joseph, J. G., Haimowitz, R., & Moon, R. Y. (2016). Strategies for improving vaccine delivery: a cluster-randomized trial. *Pediatrics, 137*(6). https://doi.org/10.1542/peds.2015-4603

Gera, T., Shah, D., Garner, P., Richardson, M., & Sachdev, H. S. (2016). Integrated management of childhood illness (IMCI) strategy for children under five. *Cochrane Database of Systematic Reviews, 2016*(6). https://doi.org/10.1002/14651858.CD010123.pub2

Hakim, H., Provencher, T., Chambers, C. T., Driedger, S. M., Dube, E., Gavaruzzi, T., Giguere, A. M. C., Ivers, N. M., MacDonald, S., Paquette, J. S., Wilson, K., Reinharz, D., & Witteman, H. O. (2019). Interventions to help people understand community immunity: a systematic review. *Vaccine, 37*(2), 235–247. https://doi.org/10.1016/j.vaccine.2018.11.016

Harvey, H., Reissland, N., & Mason, J. (2015). Parental reminder, recall and educational interventions to improve early childhood immunisation uptake: a systematic review and meta-analysis. *Vaccine, 33*, 2862–2880. https://doi.org/10.1016/j.vaccine.2015.04.085

Heneghan, C. J., Plüddemann, A., Spencer, E. A., Brassey, J., Rosca, E. C., Onakpoya, I. J., Evans, D. H., Conly, J. M., Brewer, N. T., & Jefferson, T. (2021). Interventions designed to improve vaccination uptake: scoping review of systematic reviews and meta-analyses – protocol (version 1). *medRxiv*, 2021. https://doi.org/10.1101/2021.08.18.21262232

Hu, T. Y., Decker, S. L., & Chou, S. Y. (2016). Medicaid pay for performance programs and childhood immunization status. *American Journal of Preventive Medicine, 50*(5), S51–S57. https://doi.org/10.1016/j.amepre.2016.01.012

Hui, C., Dunn, J., Morton, R., Staub, L., Tran, A., Hargreaves, S., Greenaway, C., Biggs, B., Christensen, R., & Pottie, K. (2018). Interventions to improve vaccination uptake and cost effectiveness of vaccination strategies in newly arrived migrants in the EU/EEA: a systematic review. *International Journal of Environmental Research and Public Health, 15*(10). https://doi.org/10.3390/ijerph15102065

Huillery, E., & Seban, J. (2021). Financial incentives, efforts, and performances in the health sector: experimental evidence from the Democratic Republic of Congo. *Economic Development and Cultural Change, 69*(3), 1115–1164.

Jaca, A., Mathebula, L., Iweze, A., Pienaar, E., & Wiysonge, C. S. (2018). A systematic review of strategies for reducing missed opportunities for vaccination. *Vaccine, 36*(21), 2921–2927. https://doi.org/10.1016/j.vaccine.2018.04.028

Jacobson Vann, J. C., Jacobson, R. M., Coyne-Beasley, T., Asafu-Adjei, J. K., & Szilagyi, P. G. (2018). Patient reminder and recall interventions to improve immunization rates. *The Cochrane Database of Systematic Reviews, 1*, CD003941. https://doi.org/10.1002/14651858.CD003941.pub3

Jain, M., Shisler, S., Lane, C., Bagai, A., Brown, E., Engelbert, M., Vardy, Y., Eyers, J., Leon, D. A., & Parsekar, S. S. (2022). Use of community engagement interventions to improve child immunisation in low- and middle-income countries: a systematic review and meta-analysis. *Campbell Systematic Reviews, 18*(3), e1253. https://doi.org/10.1002/cl2.1253

Jarrett, C., Wilson, R., O'Leary, M., Eckersberger, E., & Larson, H. (2015). Strategies for addressing vaccine hesitancy – a systematic review. *Vaccine, 33*(34), 4180–4190. https://doi.org/10.1016/j.vaccine.2015.04.040

Jia, L., Meng, Q., Scott, A., Yuan, B., & Zhang, L. (2021). Payment methods for healthcare providers working in outpatient healthcare settings. *Cochrane Database of Systematic Reviews,* (1). https://doi.org/10.1002/14651858.CD011865.pub2

Johri, M., Cielo Pérez, M., Arsenault, C., Sharma, J. K., Pai, N. P., Pahwa, S., & Sylvestre, M.-P. (2015). Strategies to increase the demand for childhood vaccination in low- and middle-income countries: a systematic review and meta-analysis. *Bulletin of the World Health Organization, 93*(5), 339–346C. https://doi.org/10.2471/BLT.14.146951

Juni, M. H., & Afiah, M. Z. N. (2018). Systematic review on effectiveness of methods of delivery and reminder of health education module to improve adherence on childhood immunization schedule. *International Journal of Public Health and Clinical Sciences, 5*(6), 54–73.

Katz, A., Enns, J. E., Chateau, D., Lix, L., Jutte, D., Edwards, J., Brownell, M., Metge, C., Nickel, N., Taylor, C., & Burland, E. (2015). Does a pay-for-performance program for primary care physicians alleviate health inequity in childhood vaccination rates? *International Journal for Equity in Health, 14*, 1–7. https://doi.org/10.1186/s12939-015-0231-6

Kaufman, J., Ryan, R., Walsh, L., Horey, D., Leask, J., Robinson, P., & Hill, S. (2018). Face-to-face interventions for informing or educating parents about early childhood vaccination. *The Cochrane Database of Systematic Reviews, 5*, CD010038. https://doi.org/10.1002/14651858.CD010038.pub3

Khanna, M., Loevinsohn, B., Pradhan, E., Fadeyibi, O., McGee, K., Odutolu, O., Fritsche, G. B., Meribole, E., Vermeersch, C. M. J., & Kandpal, E. (2021). Decentralized facility financing versus performance-based payments in primary health care: a large-scale randomized controlled trial in Nigeria. *BMC Medicine, 19*(1), 224. https://doi.org/10.1186/s12916-021-02092-4

Kim, S. S., Patel, M., & Hinman, A. (2017). Use of m-Health in polio eradication and other immunization activities in developing countries. *Vaccine, 35*(10), 1373–1379. https://doi.org/10.1016/j.vaccine.2017.01.058

Lukusa, L. A., Ndze, V. N., Mbeye, N. M., & Wiysonge, C. S. (2018). A systematic review and meta-analysis of the effects of educating parents on the benefits and schedules of childhood vaccinations in low and middle-income countries. *Human Vaccines & Immunotherapeutics, 14*(8), 2058–2068. https://doi.org/10.1080/21645515.2018.1457931

MacDonald, N. E. (2015). Vaccine hesitancy: definition, scope and determinants. *Vaccine, 33*(34), 4161–4164. https://doi.org/10.1016/j.vaccine.2015.04.036

Machado, A. A., Edwards Sarah, A., Mueller, M., & Saini, V. (2021). Effective interventions to increase routine childhood immunization coverage in low socioeconomic status communities in developed countries: a systematic review and critical appraisal of peer-reviewed literature. *Vaccine, 39*(22), 2938–2964. https://doi.org/10.1016/j.vaccine.2021.03.088

McKenzie, J. E. & Brennan, S. E. (2022). Synthesizing and presenting findings using other methods. In: Higgins, J. P. T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V.A. (eds). *Cochrane Handbook for Systematic Reviews of Interventions version 6.3* (updated February 2022). Available from www.training.cochrane.org/handbook

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Science, 6*, 42. https://doi.org/10.1186/1748-5908-6-42

Molina, E., Carella, L., Pacheco, A., Cruces, G., & Gasparini, L. (2016). Community monitoring interventions to curb corruption and increase access and quality of service delivery in low-and middle-income countries: a systematic review. *Campbell Systematic Reviews, 12*(1), 1–204.

Munk, C., Portnoy, A., Suharlim, C., Clarke-Deelder, E., Brenzel, L., Resch, S. C., & Menzies, N. A. (2019). Systematic review of the costs and effectiveness of interventions to increase infant vaccination coverage in low- and middle-income countries. *BMC Health Services Research, 19*(1), 10. https://doi.org/10.1186/s12913-019-4468-4

Mureed, S., Somronghtong, R., Kumar, R., Ghaffar, A., & Chapman Robert, S. (2015). Enhanced immunization coverage through interventions for childhood cluster diseases in developing countries. *Journal of Ayub Medical College Abbottabad, 27*(1), 223–227. https://www.ayubmed.edu.pk/JAMC/27-1/Mureed.pdf

Nelson, K. N., Wallace, A. S., Sodha, S. V., Daniels, D., & Dietz, V. (2016). Assessing strategies for increasing urban routine immunization coverage of childhood vaccines in low and middle-income countries: a systematic review of peer-reviewed literature. *Vaccine, 34*(46), 5495–5503. https://doi.org/10.1016/j.vaccine.2016.09.038

Nour, R. (2019). A systematic review of methods to improve attitudes towards childhood vaccinations. *Cureus, 11*(7), e5067. https://doi.org/10.7759/cureus.5067

Obregon, R., Mosquera, M., Tomsa, S., & Chitnis, K. (2020). Vaccine hesitancy and demand for immunization in Eastern Europe and Central Asia: implications for the region and beyond. *Journal of Health Communication, 25*(10), 808–815. https://doi.org/10.1080/10810730.2021.1879366

Oliver-Williams, C., Brown, E., Devereux, S., Fairhead, C., & Holeman, I. (2017). Using mobile phones to improve vaccination uptake in 21 low- and middle-income countries: systematic review. *JMIR mHealth and uHealth, 5*(10), e148. https://doi.org/10.2196/mhealth.7792

Olson, O., Berry, C., & Kumar, N. (2020). Addressing parental vaccine hesitancy towards childhood vaccines in the United States: a systematic literature review of communication interventions and strategies. *Vaccines, 8*(4), 1–25. https://doi.org/10.3390/vaccines8040590

Omoniyi, O. S., & Williams, I. (2020). Realist synthesis of the international theory and evidence on strategies to improve childhood vaccination in low- and middle-income countries: developing strategies for the Nigerian healthcare system. *International Journal of Health Policy and Management, 9*(7), 274–285. https://doi.org/10.15171/ijhpm.2019.120

Oyo-Ita, A., Wiysonge, C. S., Oringanje, C., Nwachukwu, C. E., Oduwole, O., & Meremikwu, M. M. (2016). Interventions for improving coverage of childhood immunisation in low- and middle-income countries. *Cochrane Database of Systematic Reviews, 2016*(7). https://doi.org/10.1002/14651858.CD008145.pub3

Ozawa, S., Yemeke, T. T., & Thompson, K. M. (2018). Systematic review of the incremental costs of interventions that increase immunization coverage. *Vaccine, 36*(25), 3641–3649. https://doi.org/10.1016/j.vaccine.2018.05.030

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ, 372*, n71. https://doi.org/10.1136/bmj.n71

Pal, M., Goodyear-Smith, F., & Exeter, D. (2016). Systematic review of pertussis immunisation among Asians. *International Journal of Human Rights in Healthcare, 9*(2), 135–146. https://doi.org/10.1108/IJHRH-02-2016-0002

Palmer, M. J., Henschke, N., Bergman, H., Villanueva, G., Maayan, N., Tamrat, T., Mehl, G. L., Glenton, C., Lewin, S., Fønhus, M. S., & Free, C. (2020). Targeted client communication via mobile devices for improving maternal, neonatal, and child health. *Cochrane Database of Systematic Reviews,* (8). https://doi.org/10.1002/14651858.CD013679

Perin, J., Mulick, A., Yeung, D., Villavicencio, F., Lopez, G., Strong, K. L., Prieto-Merino, D., Cousens, S., Black, R. E., & Liu, L. (2021). Global, regional, and national causes of under-5 mortality in 2000–19: an updated systematic analysis with implications for the Sustainable Development Goals. *Lancet Child & Adolescent Health*. https://doi.org/10.1016/s2352-4642(21)00311-4

Radisic, G., Chapman, J., Flight, I., & Wilson, C. (2017). Factors associated with parents' attitudes to the HPV vaccination of their adolescent sons: a systematic review. *Preventive Medicine, 95*, 26–37. https://doi.org/10.1016/j.ypmed.2016.11.019

Rajkotia, Y., Zang, O., Nguimkeu, P., Gergen, J., Djurovic, I., Vaz, P., Mbofana, F., & Jobarteh, K. (2017). The effect of a performance-based financing program on HIV and maternal/child health services in Mozambique – an impact evaluation. *Health Policy and Planning, 32*(10), 1386–1396. https://doi.org/10.1093/heapol/czx106

Ryan, R., Santesso, N., Lowe, D., Hill, S., Grimshaw, J., Prictor, M., Kaufman, C., Cowie, G., & Taylor, M. (2014). Interventions to improve safe and effective medicines use by consumers: an overview of systematic reviews. *Cochrane Database of Systematic Reviews, 2014*(4), Cd007768. https://doi.org/10.1002/14651858.CD007768.pub3

Ryman, T. K., Dietz, V., & Cairns, K. L. (2008). Too little but not too late: results of a literature review to improve routine immunization programs in developing countries. *BMC Health Services Research, 8*, 134. https://doi.org/10.1186/1472-6963-8-134

Saeterdal, I., Lewin, S., Austvoll-Dahlgren, A., Glenton, C., & Munabi-Babigumira, S. (2014). Interventions aimed at communities to inform and/or educate about early childhood vaccination. *Cochrane Database of Systematic Reviews,* (11), Cd010232. https://doi.org/10.1002/14651858.CD010232.pub2

Salami, L., Ouendo, E.-M., & Fayomi, B. (2018). Effects of results based financing models on the performance of exposed health zones in Benin. *2018, 5*(10), 12. https://doi.org/10.18203/2394-6040.ijcmph20183953

Schwethelm, B., Stefanet, S., Tomsa, S., Sanchez, S., & Bianco, V. (2021). *Protecting young children from vaccine-preventable diseases*. UNICEF Regional Office for Europe and Central Asia. https://www.unicef.org/eca/media/14246/file

Shea, B., Andersson, N., & Henry, D. (2009). Increasing the demand for childhood vaccination in developing countries: a systematic review. *BMC International Health and Human Rights, 9*(Suppl 1), S5. https://doi.org/10.1186/1472-698x-9-s1-s5

Sherry, T. B., Bauhoff, S., & Mohanan, M. (2017). Multitasking and heterogeneous treatment effects in pay-for-performance in health care: evidence from Rwanda. *American Journal of Health Economics, 3*(2), 192–226.

Thomas, J., Graziosi, S., Brunton, J., Ghouze, Z., O'Driscoll, P., & Bond, M. (2020). *EPPI-Reviewer: advanced software for systematic reviews, maps and evidence synthesis.* EPPI-Centre Software. London: UCL Social Research Institute.

UNICEF & WHO. (2021). *WHO and UNICEF estimates of national immunization coverage (WUENIC) analytics platform*. https://www.who.int/teams/immunization-vaccines-and-biologicals/immunization-analysis-and-insights/global-monitoring/immunization-coverage/who-unicef-estimates-of-national-immunization-coverage

Van de Poel, E., Flores, G., Ir, P., & O'Donnell, O. (2016). Impact of performance-based financing in a low-resource setting: a decade of experience in Cambodia. *Health Economics, 25*(6), 688–705. https://doi.org/10.1002/hec.3219

Vedio, A., Liu, E. Z. H., Lee, A. C. K., & Salway, S. (2017). Improving access to health care for chronic hepatitis B among migrant Chinese populations: a systematic mixed methods review of barriers and enablers. *Journal of Viral Hepatitis, 24*(7), 526–540. https://doi.org/10.1111/jvh.12673

Vujovich-Dunn, C., Kaufman, J., King, C., Skinner, S. R., Wand, H., Guy, R., & Leask, J. (2021). A systematic review and meta-analysis of effectiveness of decision aids for vaccination decision-making. *Vaccine, 39*(28), 3655–3665. https://doi.org/10.1016/j.vaccine.2021.05.021

Wang, S. N., Smith, H., Peng, Z. X., Xu, B. A., & Wang, W. B. (2016). Increasing coverage of hepatitis B vaccination in China: a systematic review of interventions and implementation experiences. *Medicine, 95*(19), 15. https://doi.org/10.1097/md.0000000000003693

Watterson, J. L., Walsh, J., & Madeka, I. (2015). Using mHealth to improve usage of antenatal care, postnatal care, and immunization: a systematic review of the literature. *BioMed Research International, 2015*, 153402. https://doi.org/10.1155/2015/153402

Wilder-Smith, A. B., & Qureshi, K. (2020). Resurgence of measles in Europe: a systematic review on parental attitudes and beliefs of measles vaccine. *Journal of Epidemiology and Global Health, 10*(1), 46–58. https://doi.org/10.2991/jegh.k.191117.001

Zeng, W., Shepard, D. S., Rusatira, J. D., Blaakman, A. P., & Nsitou, B. M. (2018). Evaluation of results-based financing in the Republic of the Congo: a comparison group pre-post study. *Health Policy and Planning, 33*(3), 392–400. https://doi.org/10.1093/heapol/czx195

Zizien, Z. R., Korachais, C., Compaoré, P., Ridde, V., & De Brouwere, V. (2019). Contribution of the results-based financing strategy to improving maternal and child health indicators in Burkina Faso. *International Journal of Health Planning and Management, 34*(1), 111–129. https://doi.org/10.1002/hpm.2589

Zombré, D., De Allegri, M., & Ridde, V. (2020). No effects of pilot performance-based intervention implementation and withdrawal on the coverage of maternal and child health services in the Koulikoro region, Mali: an interrupted time series analysis. *Health Policy and Planning, 35*(4), 379–387. https://doi.org/10.1093/heapol/czaa001

On 17 January 2022, seven-year- old Aleksej sitting in his mom's lap while receiving re-vaccination against diphtheria, tetanus and pertussis at 'Gjorce Petrov' Polyclinic in Skopje Macedonia.

© UNICEF/UN0582604/GEORGIEV

APPENDIX

Appendix A – Definitions

The vaccine schedule recommended by UNICEF is presented in Table 5.

TABLE 5: Vaccine schedule for common vaccine-preventable diseases (table adapted from *Protecting young children from vaccine-preventable diseases* (Schwethelm et al., 2021))

Disease	Vaccine	Timing of doses
Tuberculosis	■ Bacille Calmette Guérin (BCG)	As soon after birth as possible
Diphtheria	■ Diphtheria, tetanus and pertussis (DTP) ■ Pentavalent (DTP + hepatitis B [HepB] + *Haemophilus influenzae type b* [Hib])	DTP-containing vaccine, 3 doses: first dose at 6 weeks, intervals 4–8 weeks
Pertussis (whooping cough)	■ DTP for infants and children ■ Pentavalent (DTP+HepB+Hib)	DTP-containing vaccine, 3 doses: first dose at 6 weeks, intervals 4–8 weeks
Tetanus	■ Tetanus toxoid (TT) ■ DTP ■ Diphtheria, tetanus (DT) ■ Pentavalent (DTP+HepB+Hib)	DTP-containing vaccine, 3 doses: first dose at 6 weeks, intervals 4–8 weeks
Hepatitis B (HepB)	■ HepB ■ Pentavalent (DTP+HepB+Hib)	3–4 doses: first as soon as possible after birth, with 4-week intervals between doses
Haemophilus influenzae type b (Hib)	■ Hib ■ Pentavalent (DTP+HepB+Hib)	3 doses: first dose at 6 weeks, intervals 4 weeks
Pneumococcal disease	■ Pneumococcal conjugate vaccine (PCV) 10 ■ PCV13	3 doses: first dose at 6 weeks, intervals 4 weeks
Polio	■ Oral polio vaccine (OPV) ■ Inactivated polio vaccine (IPV)	3–4 doses: first dose at 6–8 weeks, intervals 4–8 weeks
Measles	■ Measles ■ Measles, mumps, rubella (MMR) ■ Measles, rubella (MR)	2 doses: first dose at 9–12 months
Mumps	■ Measles, mumps, rubella, varicella (MMRV)	2 doses: at 9–12 months, interval 4 weeks to school entry
Rubella (German measles)	■ MMR ■ MR	1 dose at 9–12 months
Varicella (chickenpox)	■ Varicella vaccine ■ MMRV	1–2 doses: first dose at 12–18 months, interval of 4–12 weeks
Rotavirus	■ Rotavirus vaccine	2–3 doses: first dose at 6 weeks, interval of 4 weeks

Community-level interventions are defined as those developed for defined geographic areas, or interventions targeting groups of people who share at least one common social or cultural characteristics (Saeterdal et al., 2014).

Europe and Central Asia has been defined as the 22 countries and territories that the UNICEF Europe and Central Asia Regional Office (ECARO) works in: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Georgia, Greece, Kazakhstan, Kosovo (in line with UN Security Council Resolution [UNSCR 1244]), Kyrgyzstan, Moldova, Montenegro, North Macedonia, Romania, Serbia, Tajikistan, Turkey, Turkmenistan, Ukraine, Uzbekistan.

Vaccine hesitancy is defined as the delay in acceptance, or the refusal of vaccination, despite the availability of vaccination services (MacDonald, 2015).

Appendix B – Search strategies

Two searches were run: the first to identify systematic reviews and evidence synthesis publications for all interventions, and the second to identify primary studies for incentives (material and non-material) for HCWs.

WEB OF SCIENCE SEARCH STRATEGY FOR SYSTEMATIC REVIEWS

Database: Web of Science (Core Collection)

Search fields: All searches run in Topic field except conditions to exclude

Language restrictions: Limit to English

Publication type: Articles and Review Articles only

Terms for children

baby OR babies OR boy* OR child OR children* OR childhood OR girl* OR infant* OR juvenile* OR minor* OR neonat* OR newborn* OR "new born*" OR pediatric* OR paediatric* OR schoolboy* OR schoolgirl* OR toddler* OR young*

Terms for family/community/HCWs

aunt* OR brother* OR caregiver* OR "care giver*" OR cousin* OR father* OR grandfather* OR grandmother* OR guardian* OR mother* OR parent* OR sister* OR stepmother* OR stepfather* OR uncle* OR communit* OR district* OR faith* OR families OR family OR household* OR house hold* OR neighbo* OR province* OR religious OR school* OR town* OR village* OR work OR workplace* OR clinician* OR counsellor* OR counselor* OR dentist* OR dietitian* OR doctor* OR general practitioner* OR gynaecologist* OR gynecologist* OR hospitalist* OR midwife OR midwives OR nurse* OR nutritionist* OR obstetrician* OR paediatrician* and pediatrician* OR pharmacist* OR physician* OR physiotherapist* OR psychiatrist* OR psychologist* OR psychotherapist* OR social worker* OR therapist* OR welfare worker* OR ((health* OR hospital OR medical OR nurs* OR operating room OR paramedical OR pharmac* OR psychiatric) NEAR/2 (aide* OR assistant* OR consultant* OR officer* OR personnel OR practitioner* OR professional* OR provider* OR specialist* OR staff OR worker*))

Intervention terms

appreciat* OR award* OR bonus* OR cash* OR communic* OR educat* OR engag* OR gift* OR health promotion OR "household item*" OR incentiv* OR intervention* OR marketing OR monetary OR money OR nonmonetary OR outreach OR pay OR payment OR professional development OR recogni* OR reward* OR social mobilisation OR social mobilization OR train* OR ((home OR house) NEAR/2 (call* OR care OR visit*)) OR (("mobile health") NEAR/2 (unit* OR team*))

Vaccination terms

immunis* OR immuniz* OR vaccin*

Systematic review and evidence synthesis terms

((evidence OR gap) NEAR/2 map*) OR EGM OR "meta analy*" OR metaanaly* OR "research synthes*" OR ((systematic OR rapid OR realist OR impact) NEAR/2 (review* OR assessment* OR stud*))

Remove non-relevant conditions

NOT (HPV OR papilloma* OR COVID* OR coronavirus OR influenza OR cancer*) in Title

WEB OF SCIENCE SEARCH STRATEGY FOR PRIMARY STUDIES

Database: Web of Science (Core Collection)

Search fields: All searches run in Topic field except conditions to exclude

Language restrictions: Limit to English

Publication type: Articles and Review Articles only

Terms for children

baby OR babies OR boy* OR child OR children* OR childhood OR girl* OR infant* OR juvenile* OR minor* OR neonat* OR newborn* OR new born* OR pediatric* OR paediatric* OR schoolboy* OR schoolgirl* OR toddler* OR young*

Terms for HCWs (professional)

clinician* OR counsellor* OR counselor* OR dentist* OR dietitian* OR doctor* OR general practitioner* OR gynaecologist* OR gynecologist* OR hospitalist* OR midwife OR midwives OR nurse* OR nutritionist* OR obstetrician* OR paediatrician* and pediatrician* OR pharmacist* OR physician* OR physiotherapist* OR psychiatrist* OR psychologist* OR psychotherapist* OR social worker* OR therapist* OR "welfare worker*" OR ((health* OR hospital OR medical OR nurs* OR operating room OR paramedical OR pharmac* OR psychiatric) NEAR/2 (aide* OR assistant* OR consultant* OR officer* OR personnel OR practitioner* OR professional* OR provider* OR specialist* OR staff OR worker*)

Intervention terms

appreciat* OR award* OR bonus* OR cash OR gift* OR household item* OR incentiv* OR monetary OR money OR nonmonetary OR pay OR payment OR professional development OR recogni*

Vaccination terms

immunis* OR immuniz* OR vaccin*

Impact assessment terms

CCT OR RCT OR RDD OR PSM OR propensity score matching OR regression discontinuity design OR difference* in difference* OR time series OR instrumental variable* OR cohort* OR experiment* OR quasiexperiment* OR case control OR matching OR between groups design OR time series OR counterfactual OR counter factual OR evaluat* OR before after OR pre post OR ((random* OR nonrandom* OR control* OR clinical OR comparison) NEAR/2 (trial* OR allocat* OR sampl* OR group*)) OR effect*

Remove non-relevant conditions

NOT (HPV OR papilloma* OR COVID* OR coronavirus OR influenza OR cancer*) in Title

Appendix C – Additional data on primary studies

TABLE 6: Primary studies – number of clusters, districts or facilities and study period

Author & Year	Number of clusters, districts or health facilities	Study period or follow-up
Demilew 2020	90 health posts (45 intervention, 45 control)	27 months (April 2016 – June 2018)
Ahmed 2019	Intervention districts, n=4; Control districts, n=4	3 years implementation
Bernal 2020	38 teams randomized to incentives, 37 to control	Three 6-month cycles (rewards every 6 months)
Binyaruka 2015	Intervention health facilities, n=75; control n=75	13 months
Bond 2019	434 physicians	2 years follow-up compared with 3 years pre-intervention
Carmichael 2019	38 control, 38 intervention sub-centre health facilities	28 months
Cyrus 2016	442 health facilities; 3,421 households in intervention cluster; 3,427 households in control	23–25 months after initial rollout
de Walque 2021	53 health facilities randomized to PBF, 50 to direct financing, 55 to supervision and monitoring, 48 to control	Started in July 2012, end 2015 (implemented for more than 2 years)
Falisse 2015	Assessed provinces in 2005 before PBF was rolled out, 10 provinces that benefited from PBF, and 7 control provinces where PBF was not rolled out before 2010	First developed as policy in 2006, expanded to nationwide policy in 2010. Assessed provinces in 2005 before PBF was rolled out, 10 provinces that benefited from PBF, and 7 control provinces
Fu 2016	3,147 patients from 32 practices	13-month intervention period
Hu 2016	Not stated	Data were extracted from the National Immunization Survey which monitors immunization coverage (1999 to 2011)
Huillery 2021	Cluster RCT of all 96 health areas in the district (includes 152 health facilities)	Fixed-fee payments started in 2006. In 2010, FFS replaced fixed payments in half the health areas. Pilot ended in October 2012, survey in December 2012 – February 2013
Katz 2015	6,185 children from database in intervention and comparison cohorts	N/A
Khanna 2021	23 districts (709 facilities) receiving PBF, and 25 districts (680 facilities) receiving DFF. Control group identified receiving usual care (randomly sampled) 25 districts, 276 facilities from 3 states	3 years – July 2014 to August–October 2017
Rajkotia 2017	134 facilities	33 months
Salami 2018	20 facilities in RBF financed by the World Bank with up to 50% of grant used for bonuses (PRPSS), 25 facilities in RBF financed by the Belgian Technical Cooperation with up to 70% of grant used for bonuses (PASS), 22 facilities in non-RBF arm	2011–2014
Sherry 2017	12 treatment districts, 7 control districts, plus 11 pilot districts in Phase 0, 12 treatment districts in Phase 1, and 7 control districts in Phase 2	P4P launched in 2006. Phase 2 in 2008

Author & Year	Number of clusters, districts or health facilities	Study period or follow-up
Van de Poel 2016	56 intervention districts between 1999 and 'present' (published in 2015)	First PBF scheme introduced between 1999 and 2003. Four other schemes rolled out between 2004 and 'present' (study published in 2015). Data collected from 1995 to identify trends before the schemes were introduced
Zeng 2018	3 departments implemented PBF (intervention); 2 departments non-PBF (comparison)	March 2012: pre-intervention survey; March 2014: post-intervention survey
Zizien 2019	16 health districts: 8 intervention; 8 comparison	Data analysed over period: 2013–2016, analysed in 2 periods. 2013–14 (before) and 2014–16 (after)
Zombré 2020	26 intervention centres, 95 control health centres	First quarter 2009 – last quarter of 2015: 15 quarters before intervention, 6 quarters during intervention, 7 quarters after intervention withdrawal

Abbreviations: DFF: direct facility financing; PBF: performance-based financing; RBF: results-based financing; RCT: randomized controlled trial.

TABLE 7: Detailed description of interventions included in the primary studies

Author & Year	Intervention category	Intervention description
Ahmed 2019	Financial bonus	Rural health centres and health facilities received financial incentives conditional on the quantity and quality of provided services. Up to 70% of the performance payments could be distributed as bonuses to the clinical staff, while at least 30% had to be reinvested in the facility.
Bernal 2020	Employer recognition, performance feedback, social comparison, material incentives	Teams were awarded points based on 11 maternal and child health metrics (including vaccination) and could redeem the points for in-kind incentives which were shared workplace assets (e.g., computers, air conditioners). Both study arms received performance feedback (report summarizing achievement of targets), supervision, and recognition for their achievements (report presented at event with representatives of each team and Ministry of Health authorities; high-performing teams received certificate and public recognition).
Binyaruka 2015	Financial bonus	P4P scheme. Financial payments made to health facilities and district and regional health managers as a bonus, based on achievement of targets relating to maternal and child health. At least 75% of bonus payments were distributed among HCWs with the remainder being retained by the facility for investment in drugs, supplies or minor renovation.
Bond 2019	Performance feedback	Intrinsic performance incentive: physicians provided with real-time access to their patient–physician quality scores. Physicians were already receiving P4P bonuses.
Carmichael 2019	HCW training, material goods, employer recognition	TBGI intervention comprised: HCW training + service pledge + material incentive (utensils, cookware, storage containers) + material prize + certificate + recognition (from District Magistrate, the highest administrative officer of the district administration) for teams that met their targets in all four quarters of the year.
Cyrus 2016	Financial bonus	P4P bonuses provided quarterly to HCWs, based on the volume of health services.
de Walque 2021	Financial bonus and audit and feedback	Four treatment arms: (i) PBF for improving quantity and quality of health services (including HCW bonuses), monitoring, supervision and feedback, autonomy over use of resources; (ii) same interventions as arm (i), except that direct financing not tied to performance; (iii) supervision and monitoring without additional funds; and (iv) a control group ('business-as-usual').
Demilew 2020	Combined intervention with HCW and caregiver non-material incentives	Public recognition. Tracking posters called the 'Protected Children' posters used a stamp system as a way for HEWs to track immunization. Completed posters were placed on the walls of the health facility and served as public recognition for both the HEWs and the parents.
Falisse 2015	Financial bonus	Subsidies for number of services delivered by health facility which can be used for the health facility, equipment or financial motivation of HCWs (bonuses).

Author & Year	Intervention category	Intervention description
Fu 2016	Financial bonus	P4P incentive programme designed to reward improvement in immunization coverage. Each P4P practice was eligible to receive various lump sums if the percentage of patients UTD in their individual practice increased by specified percentage points.
Hu 2016	Financial bonus	Unclear whether the P4P mechanism was a bonus (premium) or enhanced fee for service.
Huillery 2021	Financial bonus	Fixed payment versus FFS system. FFS scheme: payment depends on the volume of patients for services. Payments could be spent on staff. Both groups received the same training, equipment and supervision.
Katz 2015	Financial bonus	Unclear whether funding was paid to providers or to clinics.
Khanna 2021	Service quality training, financial bonus, audit and feedback	Combination intervention: PBF (quarterly payment based on quantity of children vaccinated verified by external agency), with quality checks linked to bonuses, audit and feedback of HCW, problem-solving, and training of facility staff on facility quality. Facilities were also encouraged to lower user fees to boost demand. Up to 50% of funds earned could be used for HCW performance bonuses, adding about 10–20% to HCW salaries. At least 50% of funds were spent on the facility, drugs, consumables, outreach. Comparison: DFF same as PBF, except payments were not linked to quantity or quality of services and no performance bonuses were paid to HCWs (facility received half the average earnings of PBF facilities). Facilities had autonomy of funds and had enhanced supervision. Control: usual care.
Rajkotia 2017	Financial bonus	PBF earnings are allocated to facility investment (40%) and salary top-ups (60%).
Salami 2018	Financial bonus	PBF – payments of subsidies proportionate to the number of services provided. In addition, facilities could receive a 25% quality bonus. Training for facility managers on best practice. Two schemes, one at national level (up to 50% of grant used for staff bonuses, World Bank funded – PRPSS), one involved departmental and local actors (up to 70% of RBF grant allocated to staff bonuses, Belgian Technical Cooperation – PASS). This was compared with DFF in which the payment was not linked to performance and no performance bonuses were paid to HCWs. Both arms engaged community leaders in facility management and strengthened supervision and quarterly training of HCWs.
Sherry 2017	Financial bonus	Bonus payment to facilities for certain quality indicators; 77% of bonuses were used to increase compensation resulting in 38% increase in staff salaries. Facility bonuses could be scaled based on quality of facilities performance. Remainder of payment used by facility.
Van de Poel 2016	Financial bonus, enhanced fee for service	Five versions of PBF strategies rolled out over study period. All included incentive payments for facility and/or staff and may also include bonuses for reaching targets. Two also included payments per unit of service. Several were operated by NGOs, and some versions of the intervention included incentives if their service targets were met.
Zeng 2018	Financial bonus	RBF scheme paid incentives to health facilities and technical teams.
Zizien 2019	Financial bonus	District executive team and regional health directorate perform trimester qualitative check-ups to grant quality bonuses to providers. In addition to the monthly wage and the usual motivations, the service providers receive bonuses according to the quantity of patients seen, the quality of care, and the satisfaction of the users. A performance contract is signed between the service providers and the administrative supervisory authorities.
Zombré 2020	Financial bonus	Facilities incentivized and received financial compensation based on set quality and quantity health indicators; 60% of funds used for facility, 40% for staff bonuses.

Abbreviations: HEW: health extension worker; NGO: non-governmental organization; P4P: pay-for-performance; PBF: performance-based financing; TBGI: Team-Based Goals and Incentives; UTD: up-to-date vaccination.

TABLE 8: Primary studies – details of intermediate outcomes

Author & Year	Intervention category	Outcome measured	Effect estimate	Direction of effect
Demilew 2020	Combined intervention with HCW and caregiver non-material incentives	Number of home visits	7.7% increase in HCW home visits (p-value = 0.2)	No effect
		HCW self-reported efficacy	Results not provided	-
de Walque 2021	Financial bonus and audit and feedback	Caregiver satisfaction for visits with children < age 5 (not just vaccination), PBF vs control	9.9 percentage point increase (p<0.05)	Significant increase
Huillery 2021	Enhanced fee for services	Caregiver reasons for not using child immunization services in past 12 months, FFS vs fixed fee	Too expensive, too far away, little interest/I don't know what it is/how it works, service is poor quality all were the same between treatments. Only waiting time for consultation showed indication of lower effect in FFS arm (p=0.077)	Mixed, no effect
		HCW provision of preventative sessions (immunization, prenatal care and family planning), FFS vs fixed payment	120 sessions in past 12 months in incentivized workers, 100 in non-incentivized workers	No effect (difference not significant)
		HCW motivation, FFS vs fixed payments	19% of FFS workers versus 11% of FP workers mention material benefits as the main advantage of their position (n=452)	No effect (p<0.1)
		HCW job satisfaction (scale 0–10), FFS vs fixed payments	Facility heads scored 5.24 for FFS workers vs 6.21 for FP workers (p=0.055). Other HCWs: 4.89 vs 5.53 (p=0.169)	No effect
Khanna 2021	Service quality training, financial bonus, enhanced fee for services, audit and feedback	Under 5 examination, average client satisfaction score, PBF vs DFF (randomized)	Difference of –1.7%, p=ns	No effect
		Under 5 examination, proportion of clients who report that facility opening hours are convenient, PBF vs DFF (randomized)	Difference of –5.2%, p=ns	No effect
		Under 5 examination, average client satisfaction score, PBF vs control (quasi-experimental)	Difference of +7.7%, p<0.1	No effect
		Under 5 examination, proportion of clients who report that facility opening hours are convenient, PBF vs control (quasi-experimental)	Difference of +7.0%, p<0.1	No effect
		Percentage of health facilities that offered routine immunizations in the week of the survey, PBF vs DFF (randomized)	Difference of +8.7%, p<0.1	No effect
		Facilities with an up-to-date routine immunization register, PBF vs DFF (randomized)	Difference of –5.0%, p<0.05	Significantly lower
		Facilities with an up-to-date routine immunization register, PBF vs control (quasi-experimental)	Difference of +8.3%, p=ns	No effect

Abbreviations: DFF: direct facility financing; FFS: fee-for-service; P4P: pay-for-performance; PBF: performance-based financing; TBGI: Team-Based Goals and Incentives; UTD: up-to-date vaccination.

TABLE 9: Primary studies – details of vaccination outcomes

Author & Year	Intervention category	Outcome measured	Vaccine assessed	Effect estimate	Direction of effect
Ahmed 2019	Financial bonus	Coverage	12–23 months: all basic vaccinations; 12–23 months: any basic vaccination; 24–35 months: all basic vaccinations; 24–35 months: MMR vaccine; 24–35 months: any vaccination		No effect
Bernal 2020	Employer recognition, performance feedback, social comparison, material incentives	Uptake post-treatment, controlling for baseline	MMR	+5.18%, p=0.14, n=2,279	No effect
Binyaruka 2015	Financial bonus	Coverage	Polio at birth, measles and pentavalent 3	Positive effect	Not significant at p<0.05 level
Bond 2019	Performance feedback	Childhood immunization status	Rotavirus	All physicians: 9 percentage point improvement in Year 1 and 8 percentage point improvement in Year 2 (p<0.001 for both years). Low-performing physicians: 3.6 percentage point improvement in Year 1 (p=0.027) and 0.6 percentage point improvement in Year 2 (p=0.021)	Significant improvement
		Childhood immunization status	Combo 3	No statistical difference for either all physicians or low-performing physicians in either Year 1 or Year 2	No effect
Carmichael 2019	HCW training, material goods, employer recognition	Team-based goal was 80–90% uptake of DTP3 by 6–11 months	DTP3		No effect
		Measles uptake for children 9–11 months (no specific team-based goal)	Measles	Positively impacted	Significant positive effect
Cyrus 2016	Financial bonus	Proportion of children aged 12–23 months with pentavalent 3 vaccination	Pentavalent		No effect (p=0.41)
Demilew 2020	HCW and caregiver non-material incentives	Full dose vaccination, non-material incentives vs control	DTP/PCV	Reduction of 1.13 percentage points (p=0.506, ns)	No effect

Author & Year	Intervention category	Outcome measured	Vaccine assessed	Effect estimate	Direction of effect
de Walque 2021	Financial bonus and audit and feedback	Uptake, PBF vs control	Final polio vaccine	4.58 increase, p=0.035 but not robust to multiple hypothesis testing adjustment	Unclear
		Uptake, DF vs control	Final polio vaccine	2.77 increase, p=ns	No effect
		Uptake, Supervision/ monitoring vs control	Final polio vaccine	1.08 increase, p=ns	No effect
		Uptake, PBF vs control	Measles	3.76 increase, p=ns	No effect
		Uptake, DF vs control	Measles	1.89 increase, p=ns	No effect
		Uptake, Supervision/ monitoring vs control	Measles	0.74 decrease, p=ns	No effect
		Complete, PBF vs control	BCG, pentavalent 1, pentavalent 2, pentavalent 3, yellow fever and measles, Documented by vaccine card	0.17 increase, p<0.10 but not robust to multiple hypothesis testing adjustment	Unclear
		Complete, DF vs control		0.05 decrease, p=ns	No effect
		Complete, Supervision/ monitoring vs control		0.02 increase, p=ns	No effect
		Complete, PBF vs control	BCG, pentavalent 1, pentavalent 2, pentavalent 3, yellow fever and measles documented by vaccine card or self-report	0.16 increase, p<0.05 but not robust to multiple hypothesis testing adjustment	Unclear
		Complete, DF vs control		0.02 decrease, p=ns	No effect
		Complete, Supervision/ monitoring vs control		0.03 increase, p=ns	No effect
Falisse 2015	Financial bonus	Uptake	Polio, BCG, DTP, MMR	Depending on the model and the vaccine assessed, change in vaccination ranged from –1.70 to +44.41	No effect in any model or vaccine
		Complete immunization	DTP, MMR, polio, BCG	Vaccination decreased in Region 1 that started PBF in 2006 (–19.54% points, p<0.01), increased in Region 2 that started PBF in 2008 (+16.56% points, p<0.05) and decreased in Region 3 that started PBF in 2009 (–11.76% points, p<0.10)	Mixed

Author & Year	Intervention category	Outcome measured	Vaccine assessed	Effect estimate	Direction of effect
Fu 2016	Financial bonus	UTD	Not reported	No significant difference in odds of being UTD	No effect
		Percentage of all needed vaccines received (PANVR) during the 12 months preceding assessment	Not reported	No significant difference	No effect
Hu 2016	Financial bonus	UTD	HepB, varicella	Increased the probability of being up to date on HepB and varicella ($p<0.05$)	Significant increase
		Uptake	MMR	Significant increase in the receipt of recommended doses of MMR ($p <0.05$)	Significant increase
		Completion	Entire 4:3:1:3:3:1 vaccine series: four doses of DTP, three doses of polio, one dose of MMR, three doses of HibB, three doses of HepB, and one dose of varicella	No significant effect on 4:3:1:3:3:1 series, nor three of the six component vaccines (DTP, polio, and Hib)	No effect
Huillery 2021	Financial bonus	At least one immunization shot and looked for BCG scar	BCG or immunization shot	Average treatment effect: –0.01, 0.01 for ever having had an immunization shot and having a scar from TB immunization, respectively	No effect
Katz 2015	Financial bonus	Rate of vaccination completion	Not reported	Inequity remained constant in P4P-funded clinics (difference in concentration index 0.006; 95% CI 0.008, 0.021), inequity in non-P4P clinics worsened	No effect
Khanna 2021	Service quality training, financial bonus, audit and feedback	Uptake, PBF vs DFF (randomized)	Pentavalent 3	Difference of –6.0%, $p<0.1$	No effect
		Uptake, PBF vs control (quasi-experimental)	Pentavalent 3	Difference of 11.1%, $p<0.05$	Significant increase
		Immunization completion, PBF vs DFF (randomized)	Fully immunized (12–23 months)	By wealth quintile, PBF had no effect in any of the quintiles compared with DFF	No effect
Rajkotia 2017	Financial bonus	Immunization completion	BCG, DTP, polio, measles	Significant positive effect on full vaccination in the first nine months ($p<0.0010$), in one intervention site (the Northern province). No evidence of effect on full vaccination in the first nine months, in the Southern province	Mixed effect

Author & Year	Intervention category	Outcome measured	Vaccine assessed	Effect estimate	Direction of effect
Salami 2018	Financial bonus, service quality training	Immunization coverage, difference in percentage compared with non-RBF areas	Pentavalent, MCV	Pentavalent PRPSS 13.3% (95% CI 12.7, 13.9); pentavalent PASS 20.5% (95% CI 19.8, 21.2); MCV PRPSS 8.9% (95% CI 8.4, 9.4); MCV PASS 4.9% (95% CI 4.5, 5.2). Positive impact for both vaccines for both RBF strategies. Significance between intervention and control not reported, but there was a significant increase in proportion vaccinated in RBF strategies and a significant decrease in non-RBF areas	Mixed effect
Sherry 2017	Financial bonus	Immunization completion, post-PFP (percentage point changes)	BCG, measles, 4 doses OPV, 3 doses DTP	3.75%	No effect
Van de Poel 2016	Financial bonus, enhanced fee for service	Complete immunization (least squares estimates)		No effect regardless of how control districts are selected and weighted	No effect
Zeng 2018	Financial bonus	Immunization coverage	DTP, BCG, full schedule	Reduction in coverage of DTP3 in children 1–5 years ($p<0.05$); a non-significant increase in BCG vaccination coverage in children aged 12–24 months; and no evidence of effect (non-significant fall) on full immunization of children	Mixed effect
Zizien 2019	Financial bonus	Full vaccination coverage (number of fully vaccinated children, 0–11 months)	Fully vaccinated	Negative but not significant impact	No effect
Zombré 2020	Financial bonus	Immunization completion	Measles	Difference of 0.02 (–0.01, 0.05) after implementation ($p>0.57$); –0.02 (–0.05, 0.01) after withdrawal of PBF ($p=0.58$)	No effect

Abbreviations: BCG: anti-tuberculosis vaccine (bacille Calmette-Guérin); DF: direct financing; DFF: direct facility financing; DTP: diphtheria, tetanus and pertussis vaccine; MCV: measles-containing vaccine; OPV: oral polio vaccine; P4P: pay-for-performance; PBF: performance-based financing; PCV: pneumococcal conjugate vaccine; TB: tuberculosis; UTD: up-to-date vaccination.

Appendix D – Quality appraisal checklists

All checklists were developed by the Joanna Briggs Institute. Checklists were selected depending on the design of the study. For all checklists, possible answers are 'Yes', 'No', 'Unclear' or 'Not Applicable'.

CRITICAL APPRAISAL CHECKLIST – SYSTEMATIC REVIEWS

- ❑ Is the review question clearly and explicitly stated?
- ❑ Were the inclusion criteria appropriate for the review question?
- ❑ Was the search strategy appropriate?
- ❑ Were the sources and resources used to search for studies adequate?
- ❑ Were the criteria for appraising studies appropriate?
- ❑ Was critical appraisal conducted by two or more reviewers independently?
- ❑ Were there methods to minimize errors in data extraction?
- ❑ Were the methods used to combine studies appropriate?
- ❑ Was the likelihood of publication bias assessed?
- ❑ Were recommendations for policy and/or practice supported by the reported data?
- ❑ Were the specific directives for new research appropriate?

CRITICAL APPRAISAL CHECKLIST – RCTS

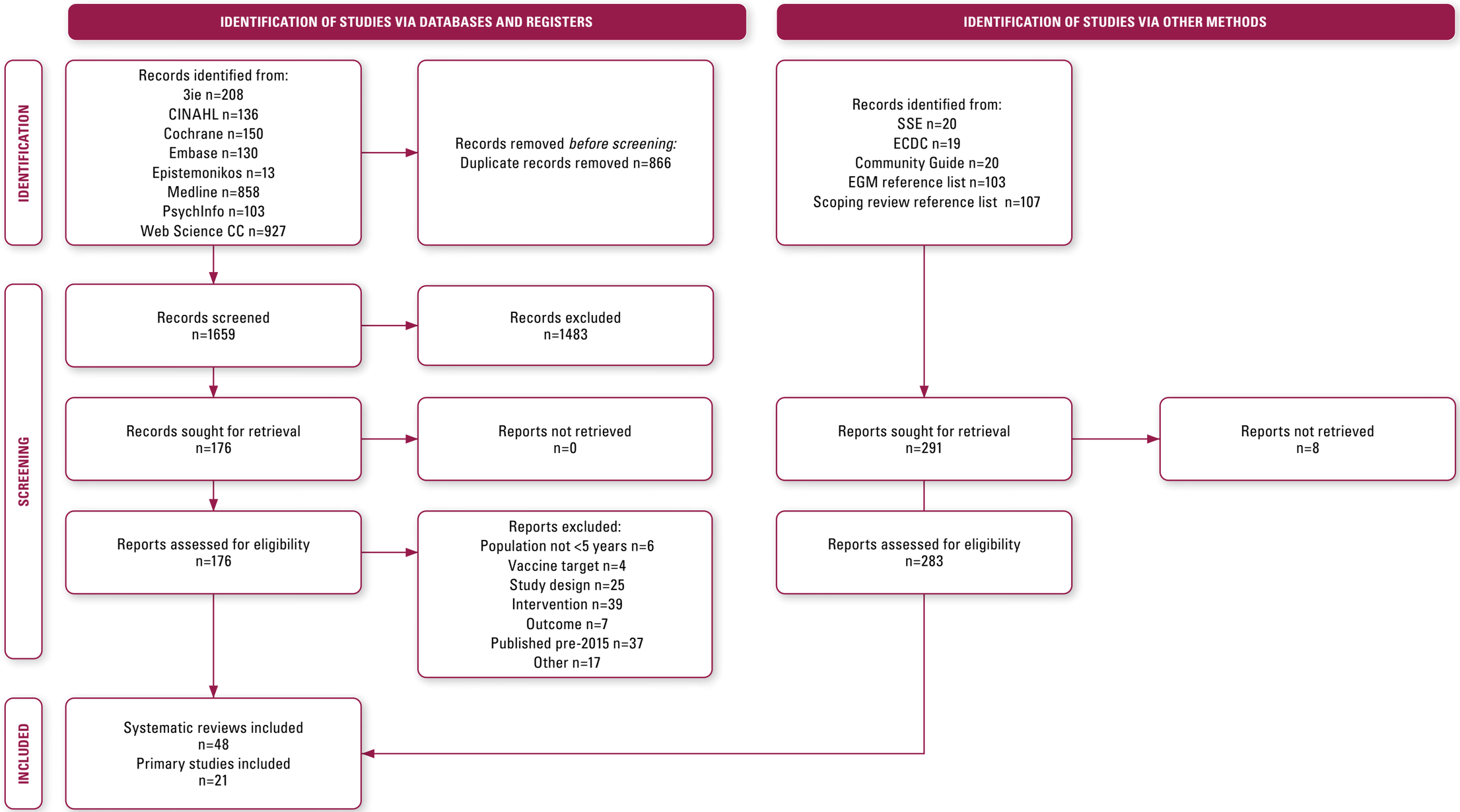
- ❑ Was true randomization used for assignment of participants to treatment groups?
- ❑ Was allocation to treatment groups concealed?
- ❑ Were treatment groups similar at the baseline?
- ❑ Were participants blind to treatment assignment?
- ❑ Were those delivering treatment blind to treatment assignment?
- ❑ Were outcomes assessors blind to treatment assignment?
- ❑ Were treatment groups treated identically other than the intervention of interest?
- ❑ Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analysed?
- ❑ Were participants analysed in the groups to which they were randomized?
- ❑ Were outcomes measured in the same way for treatment groups?
- ❑ Were outcomes measured in a reliable way?
- ❑ Was appropriate statistical analysis used?
- ❑ Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

CRITICAL APPRAISAL CHECKLIST – QUASI-EXPERIMENTAL STUDIES

- ❑ Was it clear in the study what was the 'cause' and what was the 'effect' (i.e., there was no confusion about which variable comes first)?
- ❑ Were the participants included in any comparisons similar?
- ❑ Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?
- ❑ Was there a control group?
- ❑ Were there multiple measurements of the outcome both pre and post the intervention/exposure?
- ❑ Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analysed?
- ❑ Were the outcomes of participants included in any comparisons measured in the same way?
- ❑ Were outcomes measured in a reliable way?
- ❑ Was appropriate statistical analysis used?

Appendix E – PRISMA flow diagram

FIGURE 23: Flow diagram illustrating the number of included and excluded studies at each stage of the REA. Flow diagram template from Page et al. (2021).



Abbreviations: 3ie: International Initiative for Impact Evaluation; EGM: evidence gap map; SSE: Social Systems Evidence.

Appendix F – Quality assessment

TABLE 10: Summary of quality of included systematic reviews

Author & Year	1	2	3	4	5	6	7	8	9	10	11	Overall
Abiola (2017)												Low
Akojie (2021)												Low
Baptista (2018)												Moderate
Bright (2017)												High
Bruel (2020)												Moderate
Connors (2017)												Moderate
CPSTF (2015a)*												Moderate
CPSTF (2015b)*												Moderate
CPSTF (2015c)*												Moderate
CPSTF (2015d)*												Moderate
CPSTF (2016)*												Moderate
Crocker-Buque (2017b)												Moderate
Crocker-Buque (2017a)												High
Crocker-Buque (2018)												High
de Cock (2020)												High
Deardorff (2018)												Moderate
Desai (2020)												High
Freeman (2017)												Moderate
Gera (2016)												High
Hakim (2019)												High
Harvey (2015)												High
Hui (2018)												High
Jaca (2018)												High
Jacobson (2018)												High
Jarrett (2015)												High
Jia (2021)												High
Johri (2015)												High
Juni (2018)												Moderate
Kaufman (2018)												High
Kim (2017)												Low
Lukusa (2018)												High
Machado (2021)												High
Molina (2016)												High
Munk (2019)												High
Mureed (2015)												Moderate
Nelson (2016)												High
Nour (2019)												Low
Oliver-Williams (2017)												Moderate
Olson (2020)												Moderate
Omoniyi (2020)												Moderate
Oyo-Ita (2016)												High
Ozawa (2018)												Moderate
Pal (2016)												Moderate
Palmer (2020)												High
Vedio (2017)												Low
Vujovich-Dunn (2021)												High
Wang (2016)												Moderate
Watterson (2015)												Moderate

* Details of the methodology for these studies were limited. Therefore, many questions were rated unclear due to lack of information.

Note: Studies were categorized as low, moderate or high quality based on the results of the appraisal checklists: 0–3=low quality, 4–7=moderate quality, 8–11= high quality. Questions used for quality appraisal are listed in Appendix D. Abbreviations: CPSTF: Community Preventive Services Task Force.

TABLE 11: Summary of quality of included RCTs

Author (Year)	1	2	3	4	5	6	7	8	9	10	11	12	13	Overall
Bernal (2020)														High
Carmichael (2019)														Moderate
Cyrus (2016)														High
de Walque (2021)														High
Demilew (2020)														Moderate
Fu (2016)														High
Huillery (2021)														Moderate
Khanna (2021)														Moderate

Note: Studies were categorized as low, moderate or high quality based on the results of the appraisal checklists; 0–4=low quality, 5–9=moderate quality, 10–13=high quality. Questions used for quality appraisal are listed in Appendix D.

TABLE 12: Summary of quality of included quasi-experimental studies

Author (Year)	1	2	3	4	5	6	7	8	9	Overall
Ahmed (2019)										High
Binyaruka (2015)										High
Bond (2019)										High
Falisse (2015)										High
Hu (2016)										High
Katz (2015)										Moderate
Rajkotia (2017)										Moderate
Salami (2018)										Moderate
Sherry (2017)										High
Van de Poel (2016)										High
Zeng (2018)										High
Zizien (2019)										High
Zombré (2020)										High

Note: Studies were categorized as low, moderate or high quality based on the results of the appraisal checklists; studies: 0–3=low quality, 4–6=moderate quality, 7–9=high quality. Questions used for quality appraisal are listed in Appendix D.

for every child, answers

UNICEF Regional Office for Europe and Central Asia (ECARO)
4 Route des Morillons
CH-1211 Geneva, Switzerland
Tel: (+41) 22 909 5111
www.unicef.org/eca
ecaro@unicef.org
@Unicefeca on Facebook
@UNICEFecaro on Instagram
@UNICEF_eca on Twitter
@unicefecaro on LinkedIn,
@UNICEFECA on YouTube

UNICEF Innocenti – Global Office of Research and Foresight
UNICEF HQ | Via degli Alfani 58
50121 Florence, Italy
Tel: (+39) 055 20330
researchpublications@unicef.org
www.unicef-irc.org
@UNICEFInnocenti on Twitter, LinkedIn,
Facebook, Instagram and YouTube

unicef
for every child