

Supplementary file

Contents

Appendix 1: Intervention-outcome framework	2
Appendix 2: Detailed inclusion and exclusion criteria	10
Appendix 3: List of excluded studies – after full-text screening	12
Appendix 4: List of sources and search strings	15
Appendix 5: Data extraction template	19
Appendix 6: Quality appraisal tool	22
Appendix 7: Summary of included systematic reviews	35
Appendix 8: Risk of bias of included systematic reviews	50
Appendix 9: Summary of main findings	54
Appendix 10: RVE analysis – 1 st tier synthesis	71
Appendix 11: RVE analysis – 2 nd tier synthesis	74
Appendix 12: Health-systems oriented interventions	77
Appendix 13: Community-level interventions	81
References	82

Appendix 1: Intervention-outcome framework

Interventions

Intervention		Definition/guidance	
A. Caregiver-oriented	AA. Information & education	AA1. Sustained sensitisation and education campaigns	Sustained interventions (i.e., those that are <i>not</i> designed with a fixed end date in mind) that provide targeted caregivers with information about immunisation and its importance, the vaccination schedule, or where and how to access immunisation services. For example, village health and nutrition days (VHNDs) in India in which health education and counselling services are provided to pregnant women and mothers of young children on a regular basis.
		AA2. Short-term ¹ sensitisation and education campaigns	One-off interventions (i.e., those designed with a fixed end date in mind) that provide targeted caregivers with information about immunisation and its importance, the vaccination schedule, or where and how to access immunisation services.
		AA3. Public information campaigns	Mass media campaigns through newspapers, radio and TV which provide caregivers with information about immunisation and its importance, the vaccination schedule, or where and how to access immunisation services. Because of the nature of communication mediums they cannot be targeted to a specific audience.
	AB. Incentives & motivation	AB1. Material/monetary incentives for caregivers	Interventions that incentivise caregivers to vaccinate through items with monetary value. This could be cash transfers or material goods like food or home goods.
		AB2. Non-material incentives for caregivers	Interventions that seek to motivate caregivers to vaccinate through non-material incentives like social recognition. Unlike reminder messages, interventions in this category should seek to <i>create</i> or <i>strengthen</i> a desire to vaccinate, rather than activating a standing intention to vaccinate.
		AB3. Automated voice messages to caregivers	Use of automatically-generated voice messages (usually delivered to a mobile phone) that remind caregivers about upcoming vaccinations, provide them information on place and time of vaccination and encourage them to vaccinate. While these messages may contain some motivational component (e.g., stressing the importance of vaccination in addition to reminding caregivers about an upcoming appointment), voice messages should be categorised only here and not also under “non-material incentives”, unless they rely on a substantive motivational factor like social recognition.
		AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	Use of written messages/pictorial that remind caregivers about upcoming vaccinations, provide them information on place and time of vaccination and encourage them to vaccinate. While these messages may contain some motivational component (e.g., stressing the importance of vaccination in addition to reminding caregivers about an upcoming appointment), messages should be categorised only here and not also under “non-material incentives”, unless they rely on a substantive motivational factor like social recognition.
		AB5. Changes to health system user fees	Any change to the monetary costs to users for accessing the health system. This can include introduction or elimination of fees at the point of service, or pre-payment or insurance schemes.

¹ In this review, we have amended the terminology from one-time sensitisation to short-term sensitization.

Intervention		Definition/guidance	
B. Health system-oriented	BA. Education & training	BA1. Formal health worker training and education	Programmes that train or educate formal health workers (FHWs). FHWs are typically vaccinators (and they tend to provide/prescribe medication or administer tests such as recording blood glucose level, etc.). (The only likely exception to this would be oral polio vaccination (OPV), especially supplementary polio campaigns, where CHWs or community volunteers may be enlisted to administer the vaccination.)
		BA2. Community health worker training and education	Programmes that train or educate community health workers (CHWs). CHWs are defined as “paraprofessionals or lay individuals with an in-depth understanding of the community culture and language, have received standardised job-related training of a shorter duration than health professionals, and their primary goal is to provide culturally appropriate health services to the community.” ²
	BB. Planning, implementation, monitoring	BB1. Formal health worker involvement in planning & monitoring	Interventions that give FHWs substantive roles in creating plans/strategies to deliver vaccination services and/or monitor vaccination coverage in the community.
		BB2. Community health worker involvement in planning & monitoring	Interventions that give CHWs substantive roles in creating plans/strategies to deliver vaccination services and/or monitor vaccination coverage in the community.
		BB3. Paper-based tracking	Paper-based systems (e.g., logbooks) used by health workers to keep track of children in the community who are due for upcoming vaccinations or have not received scheduled vaccinations. Note that if a study merely mentions the existence of logbooks, that is not sufficient to code it as this intervention. The logbooks must be specifically used for tracking upcoming and missed vaccinations.
		BB4. Promoting outreach to vaccine-hesitant groups	Outreach to groups that, because of religious, cultural, or other reasons, are suspicious of vaccination or have specific fears about it (e.g., that vaccinations cause infertility or spread disease).
		BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.)	Outreach to groups that are vulnerable in a way that affects their access to vaccination services. They may be in hard-to-reach geographical areas, have low socioeconomic status (including wealth and education), or be from groups marginalised based on caste, ethnicity, etc. This also includes interventions that set up temporary and mobile clinics to deliver vaccines, to make vaccination services more accessible.
		BB6. Outreach to migrant populations	Outreach to populations who have migrated temporarily or seasonally because of cultural or employment reasons.

² From Olaniran, A., Smith, H., Unkels, R., Bar-Zeev, S., & van den Broek, N. (2017). Who is a community health worker? – A systematic review of definitions. *Global Health Action*, 10(1), 1272223. <https://doi.org/10.1080/16549716.2017.1272223>.

Intervention		Definition/guidance	
		BB7. Home visits	Use of visits to caregivers' homes by health workers. This includes both visits to encourage caregivers to vaccinate their children, and visits to deliver vaccines, provided they are <i>targeted</i> visits to specific households for routine immunization. General door-to-door campaigns to deliver specific vaccines go under BC1.
		BB8. Campaigns to vaccinate refugee populations	Interventions that make a special effort to vaccinate populations which have been displaced temporarily or permanently because of conflict, war or famine.
	BC. Supplementary Immunisation Activities	BC1. National/sub-national immunisation days	Supplementary immunisation activities (SIA) are mass immunization campaigns which complement routine immunisation activities whereby a vaccine is taken simultaneously to many residents of a community within a defined short space of time. They have generally been conducted for polio and measles. They may be called national or sub-national immunisation days. They may happen through booth days or door to door vaccination campaigns. On a booth day a large number of fixed site booths are set up throughout the target area for children to be brought to receive a specific vaccine like polio. In door-to-door campaigns vaccination teams go door to door to every house, checking each child under five to see if they have received the specific vaccine, and if they have not that vaccination is provided.
	BD. Incentives & motivation	BD1. Material/monetary incentives for health workers	Interventions that incentivise formal or community health workers to deliver vaccination services through items with monetary value. This could be cash transfers or material goods like food or home goods.
		BD2. Non-material incentives for health workers	Interventions that use non-material incentives like social recognition to incentivise formal or community health workers to deliver vaccination services.
		BD3. Automated voice messages to health workers	Use of automatically-generated voice messages (usually delivered to a mobile phone) that remind health workers about upcoming vaccinations for community members, provide them information to help plan their work, and encourage them to conduct outreach to those community members.
		BD4. Written or pictorial messages (SMS, stickers, flyers etc.) to health workers	Use of written/pictorial messages that remind health workers about upcoming vaccinations for community members, provide them information to help plan their work, and encourage them to conduct outreach to those community members.
		BD5. Pay-for-performance schemes	Schemes whereby health centres or districts receive funding based on their performance in delivering health services (e.g., they receive a given amount of funding for each child vaccinated or each antenatal care visit completed). Also known as "results-based financing".
	BE. Infrastructure	BE1. Building & upgrading health clinics	Projects that build new permanent health clinics, or provide physical upgrades to existing clinics.
		BE2. Cold chain infrastructure improvements	Interventions that improve the ability of health systems to maintain vaccine cold chains.

Intervention		Definition/guidance	
	BF. Health system governance, policies and financing	BF1. Health system strategic planning	Initiatives at the national or sub-national level to develop plans and governance structures designed to improve vaccination services. This also includes interventions that improve the human resource availability, strategies, policies and plans in existing health governance and delivery structures that may or may not be directly related to immunisation services.
		BF2. Vaccination guidelines	Changes to official national or sub-national guidelines about when and how vaccinations should be administered. This includes studies comparing two different approaches to administering vaccines (e.g., one measles dose vs. two), which could be made into guidelines.
		BF3. Changes to broader governance systems (beyond health systems)	Interventions that modify general governance systems not directly related to health. An example would be a policy dictating a certain level of representation for women in local or national governing bodies.
		BF4. Health system financing	Interventions that increase the national or sub-national financing of health or specifically for vaccination in absolute terms or as a proportion of GDP. This also includes results- or performance-based financing.
	BG. Technology & mHealth	BG1. New HMIS/Dashboard systems (incl. improved data collection)	New digital tools and systems designed to improve health system capacity to monitor and deliver vaccination services. This includes apps for mobile phones or tablets, as well as desktop-based software and setting up online dashboards. A common type of intervention in this category is giving health workers tablets with an app that allows them to register vaccination information (and for other health services) for community members, track their vaccination schedules and provide them readily-accessible information about vaccination.
		BG2. Capacity building (e.g., training) for existing systems	Initiatives to train people working in the health system (including frontline health workers and administrative personnel) to improve their ability to use existing digital tools and systems more effectively.
C. Other community member-oriented	CA. Other community member-oriented	CA1. Faith-based outreach/outreach using local leaders	Interventions that enlist influential community members (often religious or other traditional leaders) to promote vaccination in the community.
D. Community-level	DA. Communication & dialogue	DA1. Collaborating with whole community	Interventions that involve or plan to involve ALL community members beyond health workers in various aspects of the intervention, such as developing plans and solutions to improve immunisation outcomes in the community.
		DA2. Collaborating with selected community groups and networks	Interventions that involve <i>selected</i> groups or networks of community members beyond health workers (other than the traditional or religious leaders who fall under CA1) in developing plans and solutions to improve immunisation outcomes in the community. This includes interventions focusing on mother's groups, father clubs, self-help groups, etc.

Intervention		Definition/guidance	
	DB. Tracking & registering	DB1. Community tracking and registering	Interventions that involve community members beyond health workers (e.g., caregivers or any other community members other than the traditional leaders who fall under CA1) in registering children with the health system so their vaccination status can be tracked, and/or tracking which children are due for vaccinations.
E. Policies and institutions	EA. Education policy and infrastructure	EA1. Education policy and infrastructure	Policy interventions that affect education levels of people in a country or region. An example would be an intervention that makes education mandatory for a particular population where it had previously been optional.
	EB. Non-health/education infrastructure	EB1. Non-health/education infrastructure (e.g., electrification)	General improvements in physical infrastructure beyond the health system. This may include electrification, roads, sanitation improvements, etc.
F. Multicomponent			

Outcomes

Outcome		Definition/guidance	
H. Behavioural, social and practical barriers faced by caregivers and communities	HAA. Thinking and feeling (attitudes, confidence)	HAA1. Knowledge about immunisation	Caregivers' knowledge about immunisation in general (i.e., its purpose and role in preventing disease)
		HAA2. Attitudes about immunisation	Caregivers' attitudes towards immunisation in general (i.e., whether they view it favourably or unfavourably or have high or low confidence in its efficacy)
		HAA3. Attitudes about health providers	Caregivers' attitudes about health providers in general (i.e., whether they generally trust health providers to provide high-quality and appropriate care)
	HAB. Social processes	HAB1. Community norms	Community-level attitudes and beliefs about immunisation, including whether there is social pressure to vaccinate or not vaccinate. This can be measured either objectively through aggregating community-level responses or subjectively by soliciting individual community members' beliefs about the norms in their community. This includes attitudes and beliefs about immunization of key influencers in the community like traditional or religious leaders.
		HAB2. Household norms & decision-making	Norms and practices determining who in a household (e.g., mother, father, mother-in-law) provides input to decisions about whether to vaccinate, and how much decision-making power individual household members have. This also covers attitudes towards immunisation of household members other than the primary caregiver.
	HAC. Readiness to vaccinate	HAC1. Readiness to vaccinate	Caregivers' motivation, intention and plan to vaccinate their children. Note this is more specific than general attitudes towards immunisation covered under HAA2

Outcome			Definition/guidance	
			HAC2. Reasons for not vaccinating	Caregivers' stated reasons for not vaccinating children. This may include factors such as convenience (which would also be coded under "perceived convenience of vaccination"), but only use this code if the factors mentioned are specifically framed as reasons for not vaccinating. Also, only use this code when the study measures <i>effects</i> of the intervention on this outcome. If the study gathers data on reasons for not vaccinating but does not provide an effect size for this as an outcome, use the cross-cutting theme but not this outcome code.
	HAD. Practical factors		HAD1. Awareness of place, time, schedule for vaccination	Caregivers' knowledge about when and where they should go for vaccinations.
			HAD2. Actual cost of vaccinating	Actual cost of vaccinating the child, including vaccine cost, transportation cost, loss of wage/income due to missed work, and providing gifts/unofficial payments to the health providers
			HAD3. Perceived convenience of vaccination	Subjective measures (i.e., caregivers' beliefs) of the convenience of taking the child for vaccination, such as opportunity costs of vaccinating a child (e.g., not able to care for a younger child), long lines at health clinic, and inconvenient day/time of vaccination.
			HAD4. Experience and satisfaction with health services	The actual experience of health services in the last visit such as duration of waiting time, availability of vaccine or vaccinator, and behaviour of the health staff (respect, rudeness). This also includes level of satisfaction with the health services, professionals and facilities.
			HAD5. Vaccination health card availability/retention	Measures of whether caregivers possess vaccination health cards provided by the health system, and/or whether caregivers can show the vaccination health card.
			HAD6. Perception of vaccination side effects	Caregivers' perceptions of the likelihood and severity of side effects from vaccination, and their knowledge of how to recognise and treat normal side effects.
I. Delivery of vaccination services	IA. Health workforce	IAA. Comm. health workers	IAA1. Community HW motivation, capacity & performance	Any measure of CHWs' capacity to deliver quality and timely vaccination services.
			IAA2. Supply of CHWs	The total availability of CHW services in the community, taking into account both the number of CHWs and the time they have available.
	IAB. Vaccinators	IAB1. Formal HW supply	The total availability of FHW services in the community, taking into account both the number of FHWs and the time they have available.	
		IAB2. Availability of HWs at vacc. point of service	Whether vaccinators are present at vaccination point of service (e.g., health clinic) when vaccination services are supposed to be offered. This includes measures of health worker "absenteeism". This is different from perception or experience of health workers from caregivers' point of view. The source of information for this outcome can be administrative data or survey of health facilities and staff.	

Outcome		Definition/guidance		
		IAB3. Formal HW motivation, capacity & performance	Any measure of FHWs' capacity to deliver quality and timely vaccination services, or of their performance in doing so.	
		IAC. Administrators	IAC1. Admin staffing	The number of staff in administrative posts in the health system (i.e., those not directly involved in health service provision).
			IAC2. Capacity of health admin. responsible for vaccination	The knowledge, skills, and motivation of staff in administrative posts in the health system, including leadership positions.
	IBA. Health information systems	IBA1. Immunisation data collection (quality, completeness)	The health system's capacity for and success in collecting data about vaccination coverage and service quality for regular monitoring and accountability.	
		IBA2. Defaulter tracing	The health system's capacity for and success in identifying vaccination "defaulters" (i.e., those whose children receive early vaccine doses but do not return for subsequent vaccinations).	
		IBA3. Supply chain management	The health system's capacity to monitor the supply of vaccines at points of service, ensure reliable supply chains, and avoid supply "bottlenecks".	
		IBA4. Immunisation data availability/ transparency	How easy it is for stakeholders within and beyond the health system to access data about vaccination service quality, coverage and timeliness.	
	ICA. Vaccine availability	ICA1. Stockouts	The frequency and duration of incidents when vaccines are out of stock at points of service, or when vaccines are in stock but cannot be administered to children who are brought in (e.g., because health workers are instructed not to open a new vial if there are not enough children to receive all doses in the vial, meaning that some of the vaccine would go to waste). Source of this information is administrative data and/or survey of health facilities and staff	
		ICA2. Quality of cold chain infrastructure	The availability, quality and upkeep of physical equipment and place for cold chain storage of vaccines	
	IDA. Resources	IDA1. National or sub-national vaccine financing	Change in financial resources for national or sub-national vaccination programmes, policies or strategies.	
	JAA. Vaccination coverage	JAA01. Full routine immunisation for children	Binary measure of whether or not children have received all routine vaccinations for the relevant country or region.	
		JAA02. BCG	Binary measure of whether or not children have received the BCG vaccine. This may be measured by checking whether children have a BCG vaccination scar.	

	JAA03. DPT1	Binary measure of whether children have received first dose of the DPT/penta vaccine. If study does not specify which doses were included in the outcome measures (i.e., the outcome is just “DPT/pentavalent vaccination” then apply this code unless it is clear they are talking about full DPT/penta vaccination, in which case code it as JAA05: DPT3).	
	JAA04. DPT2	Binary measure of whether or not children have received the second dose of the DPT or pentavalent	
	JAA05. DPT3	Binary measure of whether or not children have received the third dose of the DPT or pentavalent vaccine. If the study does not specifically say “DPT3” (or “pentavalent 3”), but refers to “complete DPT/penta vaccination”, then use this code.	
	JAA06. OPV0	Binary measure of whether children have received 1 st dose of oral polio vaccine (recommended for administration at birth).	
	JAA07. OPV1	Binary measure of whether children have received 2 nd dose of the oral polio vaccine (recommended for administration at 6 weeks).	
	JAA08. OPV2	Binary measure of whether children have received the 3 rd dose of the oral polio vaccine (recommended for administration at 10 weeks).	
	JAA09. OPV3	Binary measure of whether children have received the 4 th and final dose of the oral polio vaccine (recommended for administration at 14 weeks).	
	JAA10. IPV	Binary measure of whether children have received inactivated polio vaccine, given as injection. Countries differ in their guidelines/practices regarding IPV, so, please note the number of doses and age(s) when administered.	
	JAA11. Measles	Binary measure of whether or not children have received the measles vaccine	
	JAA12. No vs. partial routine immunisation	Proportion of children who receive at least one vaccination versus those who are completely unvaccinated.	
	JAA13. Vacc. timeliness	Proportion of vaccinations delivered on time according to the recommended schedule, vs those that are delivered late.	
	JAA14. Drop out rate for multidose vaccines	Proportion of children who fail to receive the complete course of a multidose vaccine (DPT/penta, OPV, or in some cases measles) after receiving the first dose.	
	JAA15. Vaccination coverage (unspecified)	Use this code if the evaluation or systematic review refers to impacts on routine vaccination coverage for children, but without specifying which vaccines.	
	KAA. Health outcomes	KAA1. Childhood morbidity	Incidence of vaccine-preventable diseases or symptoms associated with those diseases (e.g., diarrhoea) among children under 5.
		KAA2. Neonatal/Infant/ Child Mortality	Incidence of mortality among children below five years from all causes. Neonatal mortality refers to death of a live-born baby within the first 28 days of life. <i>Infant mortality</i> is the death of young children under the age of 1. Child mortality, refers to the mortality of children under the age of five. This category includes all-cause mortality.

Appendix 2: Detailed inclusion and exclusion criteria

1. Types of reviews

We include studies that self-identify as systematic reviews and/or meta-analyses of the impacts of interventions on outcomes related to routine child immunisation in L&MICs. These in turn have focused on synthesising quantitative, qualitative and or mixed methods evidence. According to the Campbell Collaboration,

“A systematic review summarizes the best available evidence on a specific question using transparent procedures to locate, evaluate, and integrate the findings of relevant research” (The Campbell Collaboration, 2020, p.5).

In the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2019), the following definition of systematic reviews is outlined:

“A systematic review attempts to collate all empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question. It uses explicit, systematic methods that are selected with a view to minimizing bias, thus providing more reliable findings from which conclusions can be drawn and decisions made” (Section 1.1 in Lasserson, Thomas, & Higgins, 2019, p.4).

Higgins and colleagues (2019) specify the key elements a systematic review should contain:

- A set of clearly stated objectives and pre-defined eligibility criteria
- A methodology that is clearly defined allowing reproducibility
- A search strategy that allows the identification of studies meeting the pre-defined eligibility criteria
- A critical appraisal of included studies
- A systematic synthesis, in many cases systematic reviews adopt a meta-analytical approach which is a statistical method to synthesise the results of primary studies included in a systematic review

To identify meta-analyses, the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2019) provides a useful definition:

“...meta-analysis yields an overall statistic (together with its confidence interval) that summarises the effectiveness of an experimental intervention compared with a comparator intervention. (Section 10.2 in Deeks, Higgins, & Altman, 2019, p. 242).

Not every systematic review contains a meta-analysis. For example, if too much heterogeneity exists within the evidence base in terms of study designs, conceptual framings and or outcomes, then a meta-analysis may not be appropriate and instead a narrative synthesis approach may be adopted and those were included in this review of reviews.

For the purpose of this study, we adapt the definitions outlined above and use the following inclusion criteria:

1. The study systematically searches, screens, extracts data and synthesises the evidence.
2. It describes methods used for search, screening, data extraction and synthesis in sufficient detail.

We carry out a quality appraisal of the reviews, which meet the above inclusion criteria. The critical appraisal tool used for this review (more details on this below) encapsulates the stringent inclusion criteria of the Campbell and Cochrane Collaborations as outlined above.

Types of participants

The systematic reviews and meta-analyses we have included are diverse. For example, different questions are often addressed, and a range of interventions are examined, which may look not only at immunisation outcomes such as coverage but also intermediate outcomes such as caregiver perceptions of child vaccination or capacity of health system to deliver quality child vaccination services. While the principal population of interest is children below the age of five, there may be other populations included in our analyses because of assessments of impact on intermediate outcomes. For example, some of the outcomes may have been analysed on the population of caregivers or frontline health workers and are included in our review as long as they are related to improving routine child immunisation outcomes in L&MICs using the World Bank (2022) definition³. Where systematic reviews and meta-analyses include evidence from HICs, we only considered the findings if more than 50% of studies are from L&MICs or if it is less than 50%, then at least two studies are from L&MICs and/or the evidence from L&MICs has been synthesised separately; we also considered systematic reviews and meta-analyses covering particular regions within L&MICs, e.g. Sub-Saharan Africa or fragile and conflict-affected areas; additionally we considered systematic reviews that are covering only one country within L&MICs where sufficient evidence is available for synthesis.

Types of interventions

In this systematic review of reviews, we included all systematic reviews and meta-analyses that provided evidence on the impact of any intervention on routine immunisation coverage or any intermediate outcome that precedes them in the theoretical causal chain (as outlined above). Therefore, the interventions included had to assess at least one outcome in relation to routine child immunisation (see Appendix 1, intervention-outcome framework for details).

Types of outcome measures

In this systematic review of reviews, we included all systematic reviews and meta-analyses that address any of the following outcomes: Coverage rates or timeliness of full immunisation, third dose of diphtheria, pertussis and tetanus (DPT) or pentavalent, or measles; additional antigen-specific immunisation coverage outcomes; and intermediate outcomes that precede them in the theoretical causal chain (e.g., attitudes about vaccination, and access to immunisation services) (see Appendix 1).

³ The World Bank definition of lower/middle income countries is used:
<https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>

Appendix 3: List of excluded studies – after full-text screening**Academic databases**

Sr. No.	Authors & Year	Title	Reasons
1	Asciutto et al., 2020[1]	“A systematic review of economic evaluations of neonatal and maternal healthcare in immigrant and ethnic minority women”	Exclude on country
2	Balzarini et al., 2020[2]	Does the use of personal electronic health records increase vaccine uptake? A systematic review	Exclude on country
3	Diks, Hiligsmann, & van der Putten, 2021[3]	Vaccine preferences driving vaccine-decision making of different target groups: a systematic review of choice-based experiments	Exclude on country
4	Haroune & King, 2020[4]	Factors contributing to parental 'vaccine hesitancy' for childhood immunisations	Exclude on country
5	Hutchinson & Smith, 2020[5]	Effectiveness of strategies to increase uptake of pertussis vaccination by new parents and family caregivers: A systematic review	Exclude on country
6	Jia et al., 2021[6]	Payment methods for healthcare providers working in outpatient healthcare settings	Exclude on country
7	Lambert et al., 2021[7]	Reducing burden from respiratory infections in refugees and immigrants: a systematic review of interventions in OECD, EU, EEA and EU-applicant countries	Exclude on country
8	Machado et al., 2021[8]	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	Exclude on country
9	Odone et al., 2021[9]	Current understandings of the impact of mandatory vaccination laws in Europe	Exclude on country
10	Ortiz-Sánchez et al., 2020[10]	Analysis of the Anti-Vaccine Movement in Social Networks: A Systematic Review	Exclude on country
11	Pires, 2021[11]	What is the state-of-the-art in clinical trials on vaccine hesitancy 2015-2020?	Exclude on country
12	Reñosa et al., 2021[12]	Nudging toward vaccination: a systematic review	Exclude on country
13	Bednarek & Klepacz, 2020[13]	Vaccinology education of nurses and the current immunoprophylaxis recommendations for children with juvenile idiopathic arthritis	Exclude on outcome
14	Chenet & Tapia-Limonchi, 2021[14]	Reaching the theoretical herd immunity threshold in Iquitos, Peru: are seroprevalence data enough?	Exclude on outcome
15	Chitkara et al., 2020[15]	Pertussis vaccination in mixed markets: Recommendations from the Global Pertussis Initiative	Exclude on outcome
16	Meteke et al., 2020[16]	Delivering infectious disease interventions to women and children in conflict settings: A systematic review	Exclude on outcome
17	Nnaji et al., 2021[17]	Implementation research approaches to promoting universal health coverage in Africa: a scoping review	Exclude on outcome
18	Chaney et al., 2021[18]	Every child on the map: A theory of change framework for improving childhood immunization coverage and equity using geospatial data and technologies	Exclude on study design, not a systematic review
19	Soans et al., 2021[19]	Vaccination in preterm and low birth weight infants in India	Exclude on study design, not a systematic review
20	Tankwanchi et al., 2020[20]	Taking stock of vaccine hesitancy among migrants: A scoping review protocol	Exclude on study design, not a systematic review

21	Agrawal et al., 2020[21]	Vaccine Hesitancy as a Challenge or Vaccine Confidence as an Opportunity for Childhood Immunisation in India	Not an effectiveness/intervention systematic review
22	Barbosa de Souza et al., 2021[22]	EXPERIÊNCIAS BRASILEIRAS NO ACOMPANHAMENTO DE CRESCIMENTO E DESENVOLVIMENTO INFANTIL NO CONTEXTO DA ATENÇÃO BÁSICA	Not an effectiveness/intervention systematic review
23	Berrueta et al., 2021[23]	Maternal and neonatal data collection systems in low- and middle-income countries for maternal vaccines active safety surveillance systems: A scoping review	Not an effectiveness/intervention systematic review
24	Cassocera et al., 2020[24]	40 years of immunization in Mozambique: a narrative review of literature, accomplishments, and perspectives	Not an effectiveness/intervention systematic review
25	Dansereau et al., 2020[25]	A systematic review of the agreement of recall, home-based records, facility records, BCG scar, and serology for ascertaining vaccination status in low and middle-income countries	Not an effectiveness/intervention systematic review
26	Farida, Widyaningsih, & Murti, 2020[26]	The effect of maternal education and antenatal care on basic immunization completeness in children aged 12-23 months in Asian and African: meta-analysis	Not an effectiveness/intervention systematic review
27	Galadima et al., 2021[27]	Factors influencing childhood immunisation uptake in Africa: a systematic review	Not an effectiveness/intervention systematic review
28	Kalaij, Sugiyanto, & Ilham, 2021[28]	Factors Associated With Vaccination Compliance in Southeast Asian Children: A Systematic Review	Not an effectiveness/intervention systematic review
29	Kulkarni et al., 2021[29]	Trends in Urban Immunization Coverage in India: A Meta-Analysis and Meta-Regression	Not an effectiveness/intervention systematic review
30	Laserna Jiménez et al., 2021[30]	Paediatric nursing clinical competences in primary healthcare: A systematic review	Not an effectiveness/intervention systematic review
31	Lassi et al., 2021[31]	The impact of the COVID-19 pandemic on immunization campaigns and programs: A systematic review	Not an effectiveness/intervention systematic review
32	Lieneck, Herzog, & Krips, 2021[32]	Analysis of Facilitators and Barriers to the Delivery of Routine Care during the COVID-19 Global Pandemic: A Systematic Review	Not an effectiveness/intervention systematic review
33	Wariri et al., 2021[33]	Timeliness of routine childhood vaccination in low- And middle-income countries, 1978-2021: Protocol for a scoping review to map methodologic gaps and determinants	Not an effectiveness/intervention systematic review
34	Priya et al., 2020[34]	Vaccination coverage and vaccine hesitancy among vulnerable population of India	Not an effectiveness/intervention systematic review
35	Smith, Hodson, & Rubin, 2021[35]	Parental attitudes towards mandatory vaccination; a systematic review	Not an effectiveness/intervention systematic review
36	Besnier et al., 2021[36]	Which public health interventions are effective in reducing morbidity, mortality and health inequalities from infectious diseases amongst children in low- and middle-income countries (L&MICs): An umbrella review	Exclude on study design, it is a review of reviews
37	Munk et al., 2019[37]	Systematic review of the costs and effectiveness of interventions to increase infant vaccination coverage in low- and middle-income countries	Duplicate

38	Omoniyi & Williams, 2020[38]	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	Duplicate
39	Barbosa de Souza et al., 2021[22]	Brazilian experiences in monitoring growth and child development in the context of primary care (EXPERIÊNCIAS BRASILEIRAS NO ACOMPANHAMENTO DE CRESCIMENTO E DESENVOLVIMENTO INFANTIL NO CONTEXTO DA ATENÇÃO BÁSICA)	Duplicate

Grey literature

Sr. No.	Authors & Year	Title	Reasons
1	Siribaddana, Sahay, & Hewapathirana, 2021[39]	Deploying Electronic Immunization Information Systems in Low and Middle Income Countries in Response to COVID-19: Systematic Review of Best Evidence Practices	Not an effectiveness/intervention systematic review
2	Jain et al., 2020[40]	PROTOCOL: Use of community participation interventions to improve child immunisation in low- and middle-income countries: A systematic review and meta-analysis	Exclude as it is a protocol: completed review (unpublished at the time of updated search) has been included, Jain et al., 2022[41, 42]
3	Onwuchekwa et al., 2021[43]	Systematic Review on the Impact of Conditional Cash Transfers on Child Health Service Utilisation and Child Health in Sub-Saharan Africa	Duplicate
4	Eze, Lawani & Acharya, 2021[44]	Short message service (SMS) reminders for childhood immunisation in low-income and middle-income countries: a systematic review and meta-analysis.	Duplicate

Systematic reviews previously included in EGM, excluded with reasons:

Sr. No.	Authors & Year	Title	Reasons
1	Pantoja et al., 2017[45]	Implementation Strategies for Health Systems in Low-Income Countries: An Overview of Systematic Reviews (Review)	Exclude on study design, it is a review of reviews
2	Hatt et al., 2015[46]	Impact of Health Systems Strengthening on Health	Exclude on study design, it is a review of reviews
3	Wysong, 2012[47]	Building evidence for improving childhood immunisation coverage in Africa	Exclude on study design, it is a review of reviews
4	Van Velthoven et al., 2020[48]	Use of Apps to Promote Childhood Vaccination: Protocol for a Systematic Review	Exclude as it is a protocol: final published review is included, de Cock 2020
5	Abdulrahman et al., 2017[49]	mHealth: a narrative synthesis of evidence of its application in improving childhood immunization coverage	Exclude on study design, not a systematic review
6	Aaby et al., 2016[50]	Randomized Trials Comparing Inactivated Vaccine After Medium-or High-titer Measles Vaccine With Standard Titer Measles Vaccine After Inactivated Vaccine	Not an effectiveness/intervention systematic review
7	Bhutta et al., 2008[51]	Interventions to address maternal, newborn, and child survival: what difference can integrated primary health care strategies make?	Exclude on outcomes

Appendix 4: List of sources and search strings

Electronic searches

We conducted electronic searches of the following databases of published sources:

1. MEDLINE (via Ovid)
2. CAB Global Health (Ovid)
3. EMBASE (Ovid)
4. Cochrane Controlled Trials Register (CENTRAL)
5. CINAHL (EbscoHost)
6. PsycINFO (Ovid)
7. Popline
8. Africa-wide information
9. Academic search complete
10. Scopus
11. Campbell Library

Searching other resources

To identify relevant grey literature, we searched the following databases and institutional websites:

1. Google Scholar
2. EconLit
3. IDEAS/RePEc
4. WHO Global Index Medicus
5. Pascal-Francis
6. Open-Grey
7. Grey Literature Report
8. Social Science Research Network (SSRN)
9. Eldis
10. GAVI
11. Epistemonikos
12. Innovations for Poverty Action (IPA)
13. Abdul Latif Jameel Poverty Action Lab (J-PAL)
14. 3ie Impact Evaluation Repository
15. 3ie Systematic Review Repository
16. Registry of International Development Impact Evaluations (RIDIE)
17. Global Development Network
18. World Bank Development Impact Evaluation (DIME) and Impact Evaluation Policy Papers
19. Inter-American Development Bank
20. Center for Global Development
21. Center for Effective Global Action (CEGA)
22. DFID Research for Development (R4D)
23. USAID

Search terms

L&MICs

1. (Afghanistan or Albania or Algeria or Angola or Argentina or Armenia or Armenian or Azerbaijan or Bangladesh or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Camerons or Cameron or Camerons or Cape Verde or Cabo Verde or Central African Republic or Chad or Tchad or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Cuba or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Grenada or Guatemala or Guinea or Guiana or Guyana or Haiti or Honduras or India or Maldives or Indonesia or Iran or Iraq or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Lebanon or Lesotho or Basutoland or Liberia or Libya or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Mali or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldavia or Moldovan or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or Nicaragua or Niger or Nigeria or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Papua New Guinea or Romania or

- Rumania or Roumania or Rwanda or Ruanda or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Sri Lanka or Solomon Islands or Somalia or Sudan or Suriname or Surinam or Swaziland or Eswatini or South Africa or Syria or Tajikistan or Tadjhikistan or Tadjikistan or Tadjhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Zambia or Zimbabwe or Rhodesia)
2. (Africa or Asia or Caribbean or West Indies or South America or Latin America or Central America)
 3. ((developing or less* developed or least developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor* or resource limited or resource constrained) adj (countn* or nation? or population? or world or state* or emerging econom* or global south))
 4. ((developing or less* developed or least developed or under developed or underdeveloped or middle income or low* income or resource limited or resource constrained) adj (economy or economies))
 5. (low* adj (gdp or gnp or gross domestic or gross national))
 6. (low adj3 middle adj3 countn*)
 7. (lmic or lmics or third world or lami countn*)
 8. transitional countn*
 9. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7

Immunisation

1. (immuniz* or immunis* or vaccin* or inoculat* or innoculat* or immunotherap* or prophyla*)

Young children and caregivers

24. (child* or infant* or newborn* or neonat* or prenatal or pre natal or antenatal or ante natal or babies or toddler* or preschool* or parent* or mother* or father* or maternal or paternal or caregiver* or grandparent* or grandmother* or grandfather* or family member*)

Impact evaluation methods

12. (random* or experiment* or (match* adj2 (propensity or coarsened or covariate)) or "propensity score" or "difference in difference*" or "difference-in-difference*" or "differences in difference*" or "differences-in-difference*" or "double difference*" or "quasi-experimental" or "quasi experimental" or "quasi-experiment" or "quasi experiment" or ((estimator or counterfactual) and evaluation*) or "instrumental variable*" or (IV adj2 (estimation or approach)) or regression discontinuity or time series or segment* regression)

Example full search strategy

Below we present a draft of the full search strategy used to search MEDLINE. Note that in MEDLINE's syntax, terms with strokes (e.g., Immunization/) denote Medical Subject Heading (MeSH) terms, while strings appended with "ti,ab,kw" are searched in the title, abstract, and keyword fields of records in the database.

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) <1946 to May 15, 2019> Searched 16th May 2019

- 1 (immuniz* or immunis* or vaccin* or inoculat* or innoculat* or immunotherap* or prophyla*).ti,ab,kw. (672732)
- 2 immunization/ or immunization, passive/ or immunization schedule/ or immunization, secondary/ or immunotherapy, active/ or vaccination/ or Immunization Programs/ or mass vaccination/ (158163)
- 3 Tuberculosis Vaccines/ or BCG Vaccine/ or Diphtheria-Tetanus Vaccine/ or Meningococcal Vaccines/ or Pertussis Vaccine/ or Diphtheria-Tetanus-acellular Pertussis Vaccines/ or Diphtheria-Tetanus-Pertussis Vaccine/ or Diphtheria-Tetanus Vaccine/ or Measles Vaccine/ or Mumps Vaccine/ or Rubella Vaccine/ or Measles-Mumps-Rubella Vaccine/ or Poliovirus Vaccines/ or Poliovirus Vaccine, Inactivated/ or Poliovirus Vaccine, Oral/ or Japanese Encephalitis Vaccines/ or Rotavirus Vaccine/ (49639)
- 4 or/1-3 (720583)
- 5 developing countries.sh,kf. (83271)
- 6 (Africa or Asia or Caribbean or West Indies or South America or Latin America or Central America).ti,ab,kw. (200981)
- 7 Africa/ or Asia/ or Caribbean/ or West Indies/ or South America/ or Latin America/ or Central America/ (73389)
- 8 (Africa or Central America or South America or Caribbean or Central Asia or Afghanistan or Albania or Algeria or Angola or Argentina or Armenia or Armenian or Azerbaijan or Bangladesh or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Cabo Verde or Central African Republic or Chad or Tchad or China or Colombia or Comoros or

Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Cuba or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timor or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Grenada or Guatemala or Guinea or Guiana or Guyana or Haiti or Honduras or India or Maldives or Indonesia or Iran or Iraq or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Lebanon or Lesotho or Basutoland or Liberia or Libya or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Mali or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldavia or Moldovan or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or Nicaragua or Niger or Nigeria or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Phillipines or Phillippines or Phillippines or Papua New Guinea or Romania or Rumania or Roumania or Rwanda or Ruanda or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Sri Lanka or Solomon Islands or Somalia or Sudan or Suriname or Surinam or Swaziland or Eswatini or South Africa or Syria or Tajikistan or Tadjhikistan or Tadjikistan or Tadjhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Zambia or Zimbabwe or Rhodesia).ti,ab,kw,sh. (1387951)

9 ((developing or less* developed or least developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor* or resource limited or resource constrained) adj (countr* or nation? or population? or world or state*)).ti,ab,kw. (91955)

10 ((developing or less* developed or least developed or under developed or underdeveloped or middle income or low* income or resource limited or resource constrained) adj (economy or economies)).ti,ab,kw. (504)

11 (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab,kw. (234)

12 (low adj3 middle adj3 countr*).ti,ab,kw. (12819)

13 (lmic or lmic3 or third world or lami countr*).ti,ab,kw. (6486)

14 (transitional countr* or emerging econom* or global south).ti,ab,kw. (873)

15 or/5-14 (1487811)

16 4 and 15 (80257)

17 Parents/ or Fathers/ or Mothers/ or Grandparents/ or Caregivers/ or Single Parent/ or Pregnant Women/ or Child, Preschool/ or Infant/ or Infant, Newborn/ or Infant, Low Birth Weight/ or Infant, Small for Gestational Age/ or Infant, Very Low Birth Weight/ or Infant, Extremely Low Birth Weight/ or Infant, Postmature/ or Infant, Premature/ or Infant, Extremely Premature/ (1597959)

18 (child* or infant* or newborn* or neonat* or neo nat* or prenatal or pre natal or ante natal or antenatal or baby or babies or toddler* or preschool* or parent* or mother* or father* or maternal or paternal).ti,ab,kw. (2284298)

19 or/17-18 (2893768)

20 16 and 19 (28515)

21 (random* or experiment* or (match* adj2 (propensity or coarsened or covariate)) or "propensity score" or ("difference in difference*" or "difference-in-difference*" or "differences in difference*" or "differences-in-difference*" or "double difference*") or ("quasi-experimental" or "quasi experimental" or "quasi-experiment" or "quasi experiment") or ((estimator or counterfactual) and evaluation*) or "instrumental variable*" or (IV adj2 (estimation or approach)) or regression discontinuity or time series or segment* regression).ti,ab,kw. (2983909)

22 Randomized Controlled Trial/ or Random Allocation/ or Evaluation Studies/ or Propensity Score/ or Interrupted Time Series Analysis/ or Controlled Before-After Studies/ or Controlled Clinical Trial/ or Non-Randomized Controlled Trials as Topic/ (896249)

23 or/21-22 (3415351)

24 Cost Analysis/ or Cost-Benefit Analysis/ or Quality-Adjusted Life Years/ or Economics, Medical/ or Cost of Illness/ or Health Care Costs/ or Direct Service Costs/ or Budgets/ or Health Care Sector/ or Public Expenditures/ (193420)

25 (cost-effective* or cost-benefit).ti,ab,kw. (130711)

26 ("life year" or "life years" or qaly* or daly*).ti,ab,kw. (18749)

27 ((economic* or cost*) adj6 (mortality or death* or markov)).ti,ab,kw. (17246)

28 ("cost minimi*" or "cost-utilit*" or "economic evaluation*" or "economic review*" or "cost outcome" or "cost analys*" or "economic analys*" or "budget* impact analys*").ti,ab,kw. (27594)

29 or/24-28 (301485)

30 (review or meta-analysis).pt. (2557796)

31 meta-analysis/ or "systematic review"/ (163880)

32 cochrane database of systematic reviews.jn. (14162)

33 (systematic review or literature review).ti. (130870)

34 or/30-33 (2590211)

- 35 23 or 29 or 34 (5946083)
- 36 20 and 35 (8309)
- 37 exp Animals/ (22312530)
- 38 Humans/ (17732234)
- 39 37 not (37 and 38) (4580296)
- 40 36 not 39 (7984)

Appendix 5: Data extraction template**1) General Information**

Sr. Number	
Study ID	
Short title	
Minutes taken to complete data extraction for this study	
Who's completing this form?	
Study title	
Year of publication	
Publication type	Journal article
	Published report
	Published working paper
	Thesis
Journal name/ publisher	
Journal Volume	
Journal Issue	
Research funding agency category	Academic institutions
	Charitable or private foundations
	Government agencies
	International aid agencies
	International financial institutions
	Non-profit organisation
	Not specified
Research funding agency name	
Included geographies	Sub-Saharan Africa
	South Asia
	East Asia and Pacific
	Latin America & the Caribbean
	Middle East & North Africa
	Eastern Europe and Central Asia
	North America
	Western Europe
	Global
	Unclear / unspecified
If the review focuses on only one country, specify it	
Location of intervention	Urban areas
	Rural areas
	Urban and rural areas
	Not reported
Any other relevant information you'd like to add for this section?	
Overarching main research question or primary hypothesis	
Includable comparators	No intervention
	"Business as usual" (existing ongoing treatment)
	Alternative intervention
	Placebo intervention
	No information on includable comparators provided
Search and inclusion	Have academic databases been searched?
	Have grey literature sites been searched?
	Dates of search reported?
	Was the review part of the update?
	PRISMA flow diagram presented?
	Number of included studies
	List of excluded studies provided?
Types of studies included, by study design	Quantitative studies included
	Qualitative studies included
	Mixed-methods studies included
	Unclear or information not provided
	Experimental design / RCT

Types of quantitative study designs included	Pipeline design
	Panel design or before/after AND with/without
	Either before/after OR with/without
	Natural experiment
	Basic survey
	Unclear or information not provided
Types of qualitative study designs included	Ethnographic study design
	Semi-structured interviews
	Narrative or life history
	Visual and/or participatory methods
	Documentary and/or content analysis
	Focus group discussions
	Unclear or information not provided
Types of quantitative analysis techniques applied in included studies	Econometric techniques (IV, PSM, 2SLS, DID, RDD, etc.)
	Multivariable analysis (OLS / regression-based approaches)
	Cross-tabulation / descriptive statistics
	Unclear or information not provided
Types of qualitative analysis techniques applied in included studies	Content or framework analysis
	Grounded theory or IPA
	Discourse analysis
	Narrative analysis
	Thematic analysis
	Unclear or information not provided
Any other relevant information you'd like to add for this section?	
What type of QUANTITATIVE data synthesis mechanisms were applied in the systematic review/meta-analysis?	Meta-regression
	Meta-analysis
	Description of range of effect sizes
	Vote counting - statistical significance
	Vote counting - direction of effect
	Descriptive (usually for narrative synthesis)
Unclear or information not provided	
What type of QUALITATIVE data synthesis mechanisms were applied in the systematic review/meta-analysis?	Narrative synthesis
	Thematic synthesis
	Meta-ethnography
	Context-mechanism analysis
	Qualitative comparative analysis
	Unclear or information not provided
Subgroup analysis	Was subgroup analysis conducted?
	Please briefly describe the nature of the subgroup analysis
Publication bias and funnel	Did the authors include a discussion of publication bias?
	Were funnel plots reported?
	Were Funnel Asymmetry and Precision Effects tests reported?
	Did the FAT-PET show evidence of publication bias? (Specific test for meta-regression)
	Any other relevant information you'd like to add for this section?
Other	Does the systematic review/meta-analysis provide a GRADE rating?
	What are the quality assessment tool(s) / risk of bias procedure in the study?
	Has the cost effectiveness analysis of the intervention(s) been included?
	If yes, what was the main cost measure that was used/calculated? (e.g., total intervention costs, intervention costs per person, incremental costs, incremental cost-effectiveness ratios (ICER) etc.)
	Did the study do sensitivity analysis?
	If yes, describe the kind of sensitivity analysis done. If no, what was the reason if acknowledged.
	Limitations of the systematic review/meta-analysis acknowledged by the authors

2) Outcome data

Intervention Code (from immunisation EGM)

Intervention description
Intervention notes
Outcome code (from immunisation EGM)
Outcome description
Outcome notes
Further information about outcome classification
Unit of measurement
Sample size (number of studies and number of participants)
Population level analysed
Sub-population(s) analysed
Direction of outcome (favourable, unfavourable, inconclusive)
Are meta-analysis regression results presented for this outcome?
How many effect sizes are reported for this outcome?
Summary of the key conclusions drawn
Narrative or other type of synthesis trend result
Narrative or other type of synthesis summary quote
Any other relevant information you'd like to add for this section?
Grade rating
Source (page number)

3) Meta-analysis data

Quantitative data extraction
Intervention Code (from immunisation EGM)
Outcome code (from immunisation EGM)
Dependent variable name for the effect size (exact terminology as listed in the systematic review/meta-analysis)
Type of effect size reported
Effect size (the actual figure)
Significance level
Confidence interval (95%)
Sample size (number of studies)
Heterogeneity
Did the authors describe likely explanatory factors of heterogeneity?
If so, please note the key factors put forward
Was a sensible method used to explore the extent to which key factors explained heterogeneity?
If so, which
If applicable, mention the test for heterogeneity
If applicable, provide heterogeneity statistics
If applicable, provide confidence interval of heterogeneity statistics
If meta-analysis is done by subgroup, then describe it
Effect size by subgroup, actual figure
Confidence interval of effect size by subgroup
Source (page number, table number, etc.)
Additional notes

Appendix 6: Quality appraisal tool**Checklist for making judgements about how much confidence to place in a systematic review of effects (adapted version of SURE checklist)**

Assessed by:
Date:

Section A: Methods used to identify, include and critically appraise studies

<p>A.1 Were the criteria used for deciding which studies to include in the review reported?</p> <p>Did the authors specify:</p> <p><input type="checkbox"/> Did the authors specify Types of studies?</p> <p><input type="checkbox"/> Did the authors specify Participants/ settings/ population?</p> <p><input type="checkbox"/> Did the authors specify Intervention(s)?</p> <p><input type="checkbox"/> Did the authors specify Outcome(s)?</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><i>Coding guide - check the answers above</i></p> <p><i>YES: All four should be yes</i></p> <p><i>NO: All four should be no</i></p> <p><i>PARTIALLY: Any other</i></p>
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<p>A.2 Was the search for evidence reasonably comprehensive? Were the following done:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Language bias avoided (no restriction of inclusion based on language) <input type="checkbox"/> No restriction of inclusion based on publication status <input type="checkbox"/> Relevant databases searched <p>Minimum criteria: at least one database that includes grey/unpublished literature, as well as either: (a) for health, at least two relevant comprehensive subject databases (such as PubMed/MEDLINE, EMBASE and CENTRAL), or (b) for social sciences, at least two relevant comprehensive subject databases (such as IDEAS) and one comprehensive general database (such as EconLit, PsychInfo, Scopus. If the search is for studies in China, the CNKI (China National Knowledge infrastructure) is acceptable as a comprehensive database.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Reference lists in included articles checked <input type="checkbox"/> Authors/experts contacted 	<ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> Partially <input type="checkbox"/> No <input type="checkbox"/> Can't tell <p><i>Coding guide - check the answers above:</i> <i>YES: All five should be yes</i> <i>PARTIALLY: Relevant databases and reference lists are both reported</i> <i>NO: Any other</i></p> <p>Note: Grey literature typically means research that is not published in sources such as books or journal articles. The following databases include grey literature: Academic Search Complete (includes many conference proceedings), CAB Abstracts, search conducted using CADATH checklist, clinicaltrials.gov, Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Library, Embase (includes 3.6m+ conference abstracts), Google, Google Scholar, Healthcare Management Information Consortium (HMIC), IDEAS/RePEc, National Technical Information Service (NTIS), OpenSIGLE/OpenGrey, PsycEXTRA, Scopus (includes ~10m conference papers). If you identify additional sources, please add to the list. Searching websites of relevant governmental agencies and non-governmental organisations or other organisations such as the WHO can also identify grey literature. Note that MEDLINE/PubMed, a comprehensive data base of journals, does not include grey literature: "For indexing in MEDLINE, NLM currently selects publications that it considers to be journals."; see also Citrome L. Beyond PubMed: Searching the "Grey Literature" for Clinical Trial Results. <i>Innov Clin Neurosci.</i> 2014;11(7-8):42-46.</p>
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<p>A.3 Does the review cover an appropriate time period? <i>Is the search period comprehensive enough that relevant literature is unlikely to be omitted?</i></p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> Can't tell <input type="checkbox"/> No <i>Coding guide:</i> <i>YES: Generally, this means searching the literature at least back to 1990</i> <i>NO: Generally, if the search does not go back to 1990</i> <i>CAN'T TELL: No information about time period for search</i> <i>Note: With reference to the above – there may be important reasons for adopting different dates for the search, e.g., depending on the intervention. If you think there are limitations with the timeframe adopted for the search which have not been noted and justified by the authors, you should code this item as a NO and specify your reason for doing so in the comment box below. Older reviews should not be downgraded, but the fact that the search was conducted some time ago should be noted in the quality assessment. Always report the time period for the search in the comment box. If the authors do not report the search period, check the publication date of the earliest included study. If the study was published before 1990 this can be coded Yes.</i></p>
<p>A.4 Was bias in the selection of articles avoided? Did the authors specify: <input type="checkbox"/> Independent screening of full text by at least 2 reviewers <input type="checkbox"/> List of included studies provided <input type="checkbox"/> List of excluded studies provided</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> Partially <input type="checkbox"/> No <i>Coding guide:</i> <i>YES: All three should be yes, although reviews published in journals are unlikely to have a list of excluded studies (due to limits on word count) and the review should not be penalised for this.</i> <i>PARTIALLY: Independent screening and list of included studies provided are both reported</i> <i>NO: All other. If list of included studies provided, but the authors do not report whether or not the screening has been done by 2 reviewers review is downgraded to NO.</i> <i>Note: The answer linked to list of included studies provided criteria is from the question "Was a table or summary of the results of the included studies provided?" in the data extraction form.</i></p>

<p>A.5 Did the authors use appropriate criteria to assess the quality and risk of bias in analysing the studies that are included?</p> <p><input type="checkbox"/> The criteria used for assessing the quality/ risk of bias were reported</p> <p><input type="checkbox"/> A table or summary of the assessment of each included study for each criterion was reported</p> <p><input type="checkbox"/> Sensible criteria were used that focus on the quality/ risk of bias (and not other qualities of the studies, such as precision or applicability/external validity). <i>“Sensible” is defined as a recognised quality appraisal tool/ checklist, or similar tool which assesses bias in included studies. Please see footnotes for details of the main types of bias such a tool should assess.</i> <i>Identified tools with sensible criteria include: Academy of Nutrition and Dietetics Quality Criteria Checklist, Child Health Epidemiology Reference Group (CHERG) study design & quality standards , Cochrane Handbook, The Delphi List, Effective Public Health Practice Project (EPHPP) Quality Assessment Tool, Grading of Recommendations Assessment, Development and Evaluation (GRADE) RoB criteria, Guide to Community Preventative Services Study Quality tool, Joanna Briggs Institute Checklists for RCT/QED, National Institutes of Health’s Quality Assessment Tool for Controlled Intervention Studies (sometimes labelled NHLBI tool). For case-control studies and cohort studies, the Newcastle-Ottawa Scale uses sensible criteria that are focused on risk of bias as does Methodological Index for Non-Randomised Studies (MINORS). Note that these designs typically are not as rigorous as RCTs or even QEDs.</i></p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><i>Coding guide:</i> <i>YES: All three should be yes</i> <i>PARTIALLY: The first and third criteria should be reported. If the authors report the criteria for assessing risk of bias and report a summary of this assessment for each criterion, but the criteria may be only partially sensible (e.g., do not address all possible risks of bias, but do address some), we downgrade to PARTIALLY.</i> <i>NO: Any other</i></p>
<p>A.6 Overall – how much confidence do you have in the methods used to identify, include and critically appraise studies?</p> <p><i>Summary assessment score A relates to the 5 questions above.</i> <i>High confidence applicable when the answers to the questions in section A are all assessed as ‘yes’</i> <i>Low confidence applicable when any of the following are assessed as ‘NO’ above: not reporting explicit selection criteria (A1), not conducting reasonably comprehensive search (A2), not avoiding bias in selection of articles (A4), not assessing the risk of bias in included studies (A5)</i> <i>Medium confidence applicable for any other – i.e. section A3 is assessed as ‘NO’ or ‘can’t tell and remaining sections are assessed as ‘partially’ or ‘can’t tell’</i></p>	<p><input type="checkbox"/> Low confidence (limitations are important enough that the results of the review are not reliable)</p> <p><input type="checkbox"/> Medium confidence (limitations are important enough that it would be worthwhile to search for another systematic review and to interpret the results of this review cautiously, if a better review cannot be found)</p> <p><input type="checkbox"/> High confidence (only minor limitations)</p>

Section B: Methods used to analyse the findings

<p>B.1 Were the characteristics and results of the included studies reliably reported? Was there:</p> <p><input type="checkbox"/> Independent data extraction by at least 2 reviewers</p> <p><input type="checkbox"/> A table or summary of the characteristics of the participants, interventions and outcomes for the included studies (Forest plots are an appropriate summary of the results, as is reporting summarises the findings by outcome domain.)</p> <p><input type="checkbox"/> A table or summary of the results of all the included studies</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> Not applicable (e.g., no included studies)</p> <p><i>Coding guide:</i> <i>YES: All three should be yes</i> <i>PARTIALLY: Criteria one and three are yes, but some information is lacking on second criteria.</i> <i>No: None of these are reported. If the review does not report whether data was independently extracted by 2 reviewers (possibly a reporting error), we downgrade to NO.</i> <i>NOT APPLICABLE: if no studies/no data</i> <i>Note: Independent extraction means that both extractors extracted all data without knowing what the other extractor decided (that is, one extractor and one verifier does not meet criterion). If the authors note two reviewers and do not use the word “independent” but mention a third reconciler to resolve differences, assume independence. When authors do not mention whether independent extraction was conducted by at least two reviewers, code No.</i></p>
<p>B.2 Are the methods used by the review authors to analyse the findings of the included studies clear, including methods for calculating effect sizes if applicable?</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Not applicable (e.g., no studies or no data)</p> <p><i>Coding guide:</i> <i>YES: Methods used clearly reported. If it is clear that the authors use narrative synthesis, they don't need to say this explicitly.</i> <i>PARTIALLY: Some reporting on methods but lack of clarity</i> <i>NO: Nothing reported on methods</i> <i>NOT APPLICABLE: if no studies/no data</i></p>

<p>B.3 Did the review describe the extent of heterogeneity?</p> <p><input type="checkbox"/> Did the review ensure that included studies were similar enough that it made sense to combine them, sensibly divide the included studies into homogeneous groups, or sensibly conclude that it did not make sense to combine or group the included studies?</p> <p><input type="checkbox"/> Did the review discuss the extent to which there were important differences in the results of the included studies?</p> <p><input type="checkbox"/> If a meta-analysis was done, was the I^2, chi square test for heterogeneity or other appropriate statistic reported? If no statistical test was reported, is a qualitative justification made for the use of random effects?</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Not applicable (e.g., no studies or no data)</p> <p><i>Coding guide:</i></p> <p><i>YES: First two should be yes, and third category should be yes if applicable should be yes</i></p> <p><i>PARTIALLY: The first category is yes</i></p> <p><i>NO: Any other</i></p> <p><i>NOT APPLICABLE: if no studies/no data</i></p> <p><i>Note: Code B3.1 No if analyses include studies with implausibly different interventions, comparisons, or populations. If a narrative synthesis, the authors need to have a rationale for why studies were not combined (such as interventions were too different) For meta-analyses, reporting a metric for heterogeneity is sufficient for B3.2. For non-meta-analysis, mentioning heterogeneity in results is enough (for example, The impacts varied from X to Y or Study A found X and Study B found Y).</i></p>
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<p>B.4 Were the findings of the relevant studies combined (or not combined) appropriately relative to the primary question the review addresses and the available data?</p> <p>How was the data analysis done?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Descriptive only <input type="checkbox"/> Vote counting based on direction of effect <input type="checkbox"/> Vote counting based on statistical significance <input type="checkbox"/> Description of range of effect sizes <input type="checkbox"/> Meta-analysis <input type="checkbox"/> Meta-regression <input type="checkbox"/> Other: specify <input type="checkbox"/> Not applicable (e.g., no studies or no data) <p>How were the studies weighted in the analysis?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Equal weights (this is what is done when vote counting is used) <input type="checkbox"/> By quality or study design (this is rarely done) <input type="checkbox"/> Inverse variance (this is what is typically done in a meta-analysis) <input type="checkbox"/> Number of participants (sample size) <input type="checkbox"/> Other: specify <input type="checkbox"/> Not clear <input type="checkbox"/> Not applicable (e.g., no studies or no data) <p>Did the review address unit of analysis errors?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Yes - took clustering into account in the analysis (e.g., used intra-cluster correlation coefficient) <input type="checkbox"/> No, but acknowledged problem of unit of analysis errors <input type="checkbox"/> No mention of issue <input type="checkbox"/> Not applicable - no clustered trials or studies included 	<ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> Partially <input type="checkbox"/> No <input type="checkbox"/> Not applicable (e.g., no studies or no data) <input type="checkbox"/> Can't tell <p><i>Coding guide:</i> YES: <i>If appropriate table, graph or meta-analysis AND appropriate weights AND unit of analysis errors addressed (if appropriate).</i> PARTIALLY: <i>If appropriate table, graph or meta-analysis AND appropriate weights AND unit of analysis errors not addressed (and should have been).</i> NO: <i>If narrative OR vote counting (where quantitative analyses would have been possible) OR inappropriate reporting of table, graph or meta-analyses.</i> NOT APPLICABLE: <i>if no studies/no data</i> CAN'T TELL: <i>if unsure (note reasons in comments below)</i></p>
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<p>B. 5 Does the review report evidence appropriately?</p> <p><input type="checkbox"/> The review makes clear which evidence is subject to low risk of bias in assessing causality (attribution of outcomes to intervention), and which is likely to be biased, and does so appropriately</p> <p><input type="checkbox"/> Where studies of differing risk of bias are included, results are reported and analysed separately by risk of bias status (No)</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partially <input type="checkbox"/> Not applicable</p> <p><i>Coding guide:</i> YES: Both criteria should be fulfilled (where applicable) NO: Criteria not fulfilled PARTIALLY: Only one criterion fulfilled, or when there is limited reporting of quality appraisal (the latter applies only when inclusion criteria for study design are appropriate) NOT APPLICABLE: No included studies</p> <p><i>Note on reporting evidence and risk of bias:</i> For reviews of effects of 'large n' interventions, experimental and quasi-experimental designs should be included (if available). For reviews of effects of 'small n' interventions, designs appropriate to attribute changes to the intervention should be included (e.g., pre-post with assessment of confounders)</p> <p><i>Making clear which evidence is subject to low risk of bias can be accomplished in a table listing RoB for each study or by listing RoB for each study on each RoB criterion; that is, if A5.2 is Yes, then B5.1 is Yes (but the reverse is not true). Reporting only study design is not sufficient to meet B5.1. For B5.2, narrative analysis must group or report by RoB, it is not sufficient to simply report RoB of each study. If the systematic review does not use sensible criteria to assess RoB, then B5.1 is No.</i></p>
<p>B.6 Did the review examine the extent to which specific factors might explain differences in the results of the included studies?</p> <p><input type="checkbox"/> Were factors that the review authors considered as likely explanatory factors clearly described?</p> <p><input type="checkbox"/> Was a sensible method used to explore the extent to which key factors explained heterogeneity?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Descriptive/textual <input type="checkbox"/> Graphical <input type="checkbox"/> Meta-analysis by subgroups <input type="checkbox"/> Meta-regression <input type="checkbox"/> Other 	<p><input type="checkbox"/> Yes <input type="checkbox"/> Partially <input type="checkbox"/> No <input type="checkbox"/> Not applicable</p> <p><i>Coding guide:</i> YES: Explanatory factors clearly described and appropriate methods used to explore heterogeneity PARTIALLY: Explanatory factors described but for meta-analyses, subgroup analysis or meta-regression not reported (when they should have been) NO: No description or analysis of likely explanatory factors NOT APPLICABLE: e.g., too few studies, no important differences in the results of the included studies, or the included studies were so dissimilar that it would not make sense to explore heterogeneity of the results</p>

B.7 Overall - how much confidence do you have in the methods used to analyse the findings relative to the primary question addressed in the review?

Summary assessment score B relates to the 5 questions in this section, regarding the analysis.

High confidence applicable when all the answers to the questions in section B are assessed as 'yes'.

Low confidence applicable when any of the following are assessed as 'NO' above: critical characteristics of the included studies not reported (B1), not describing the extent of heterogeneity (B3), combining results inappropriately (B4), reporting evidence inappropriately (B5).

Medium confidence applicable for any other: i.e., the "Partial" option is used for any of the 6 preceding questions or questions and/or B.2 and/or B.6 are assessed as 'no'.

Low confidence (limitations are important enough that the results of the review are not reliable)

Medium confidence (limitations are important enough that it would be worthwhile to search for another systematic review and to interpret the results of this review cautiously, if a better review cannot be found)

High confidence (only minor limitations)

Section C: Overall assessment of the reliability of the review

C.1 Are there any other aspects of the review not mentioned before which lead you to question the results?	<input type="checkbox"/> Additional methodological concerns – only one person reviewing <input type="checkbox"/> Robustness <input type="checkbox"/> Interpretation <input type="checkbox"/> Conflicts of interest (of the review authors or for included studies) <input type="checkbox"/> Other <input type="checkbox"/> No other quality issues identified
C.2 Are there any mitigating factors which should be taken into account in determining the reviews reliability?	<input type="checkbox"/> Limitations acknowledged <input type="checkbox"/> No strong policy conclusions drawn (including in abstract/ summary) <input type="checkbox"/> Any other factors
<p>C.3 Based on the above assessments of the methods how would you rate the reliability of the review?</p> <p><input type="checkbox"/> <u>Low confidence in conclusions about effects:</u> This review differs from the typical effectiveness review in that it combines evaluations with descriptive studies, and has no methodological exclusion criteria. Moreover, the authors do not perform any sort of risk of bias assessment on the evaluative studies, nor clearly report the methods used in included studies, making it difficult to know how much confidence to place in the results. There are major gaps in the reporting of the search (databases not listed) and screening (no discussion of how this was done). The authors do note the limitations of the review, including the language restrictions and the limited reporting on pre- and post-intervention coverage rates in the included studies.</p> <p><input type="checkbox"/> <u>Medium confidence in conclusions about effects:</u> The systematic review has the following limitations.</p> <p><input type="checkbox"/> <u>High confidence in conclusions about effects:</u> If applicable: The review has the following minor limitations...</p> <p><i>Coding guide:</i> High confidence in conclusions about effects: high confidence noted overall for sections A and B, unless moderated by answer to C1. Medium confidence in conclusions about effects: medium confidence noted overall for sections A or B, unless moderated by answer to C1 or C2. Low confidence in conclusions about effects: low confidence noted overall for sections A or B, unless moderated by answer to C1 or C2. Limitations should be summarised above, based on what was noted in Sections A, B and C.</p>	

Section D

D.1. Does the review use a programme theory? <input type="checkbox"/> Did the authors present: A logic model articulating the intervention causal chain from inputs/activities through to outcomes? <input type="checkbox"/> Did the authors present: Assumptions, either in the logic model itself or discussed in supporting text? <input type="checkbox"/> Did the authors present: A (middle-range) theory (economic theory, e.g. trade theory; social theory, e.g. diffusion theory; etc.) which informed the logic models and/or from which inferences can be made about mechanisms and contexts under which outcomes might occur?	<input type="checkbox"/> Yes <input type="checkbox"/> Partially <input type="checkbox"/> No <i>Coding guide:</i> <i>YES: Some theory is used, whether an intervention level logic model or causal chain, or formal theory, and underlying assumptions are explicitly described.</i> <i>NO: None are reported.</i> <i>PARTIALLY: A theory is used but underlying assumptions are not reported.</i>
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<p>D.2. Does the review incorporate qualitative evidence in the design?</p> <p><input type="checkbox"/> Was the logic model or theory articulated at protocol stage?</p> <p><input type="checkbox"/> Is qualitative evidence cited in the development or explanation of the theoretical approach/logic model?</p> <p><input type="checkbox"/> Is qualitative evidence incorporated systematically (i.e., based on systematic searches), in order to develop the theoretical approach/logic model?</p> <p><input type="checkbox"/> Is qualitative evidence cited in development of relevant questions?</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><i>Coding guide:</i> <i>YES: At least 1 and 2 or 3 are reported.</i> <i>NO: None are reported.</i> <i>PARTIALLY: 1 or 4 are reported.</i></p>
<p>D.3. Did the review conduct analysis of intermediate and endpoint outcomes along causal chain?</p> <p><input type="checkbox"/> Did the review conduct analysis of primary endpoint outcomes?</p> <p><input type="checkbox"/> Did the review conduct analysis of primary intermediate outcomes?</p> <p><input type="checkbox"/> Did the review conduct analysis of secondary endpoint outcomes?</p> <p><input type="checkbox"/> Did the review conduct analysis of secondary intermediate outcomes?</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Not applicable</p> <p><input type="checkbox"/> Can't tell</p> <p><i>Coding guide:</i> <i>YES: Boxes 1 and 2 are ticked</i> <i>PARTIALLY: Boxes 1 and 4 or 2 and 3 are ticked.</i> <i>NO: analysis of outcomes along causal chain is not undertaken and only endpoint outcomes are analysed (and outcomes at different stages of the causal chain were excluded).</i> <i>NOT APPLICABLE: if no studies/no data</i> <i>CAN'T TELL: if unsure (note reasons in comments below)</i></p>
<p>D.4. Does the review incorporate qualitative evidence in the analysis?</p> <p><input type="checkbox"/> To answer specific review questions about intervention design (e.g., project portfolio information)</p> <p><input type="checkbox"/> To answer specific review questions about barriers and facilitators/enablers of implementation (assumptions or risks in the causal chain/ logic model)</p> <p><input type="checkbox"/> To answer specific review questions about adherence or participant views?</p> <p><input type="checkbox"/> To provide information on context for included quantitative studies (e.g., moderators or implementation fidelity)?</p> <p><input type="checkbox"/> To provide evidence on 'middle-range' causal mechanisms or contextual factors (e.g., policy context, second order changes e.g., general equilibrium effects, sustained adherence)</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><i>Coding guide:</i> <i>YES: 1, 2, or 3 plus 4 or 5 are reported.</i> <i>NO: None are reported.</i> <i>PARTIALLY: Any other combination.</i></p>

<p>D.5. Does the review incorporate qualitative evidence in other aspects of the analysis?</p> <p><input type="checkbox"/> To assess applicability of synthesised evidence to particular contexts?</p> <p><input type="checkbox"/> To discuss the quantitative findings in light of qualitative evidence, drawing on qualitative evidence collected systematically?</p> <p><input type="checkbox"/> To discuss the quantitative findings in light of qualitative evidence (i.e., in the discussion section only), not drawing on evidence collected systematically?</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><i>Coding guide:</i> <i>YES: 1 or 2 are reported.</i> <i>NO: None are reported.</i> <i>PARTIALLY: 3 is reported.</i></p>
<p>D.6. Does the review integrate the findings from quantitative and qualitative evidence?</p> <p><input type="checkbox"/> Is qualitative evidence: Presented in a separate results section?</p> <p><input type="checkbox"/> Is qualitative evidence: Integrated with evidence on effects using qualitative methods (e.g., further iterations of the theory of change)</p> <p><input type="checkbox"/> Is qualitative evidence: Integrated with evidence on effects using quantitative methods (e.g. through formal statistical testing of moderators and subgroups identified in qualitative analysis)</p> <p><input type="checkbox"/> Is qualitative evidence: Some other method to integrate the evidence? (specify)</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><i>Coding guide:</i> <i>YES: 1 and 2 or 3 are reported.</i> <i>NO: None are reported.</i> <i>PARTIALLY: 1 is reported only.</i></p>
<p>D.7. Is quantitative and qualitative evidence integrated to form conclusions and implications?</p> <p><input type="checkbox"/> Weight of quantitative evidence assessed using GRADE or other methods</p> <p><input type="checkbox"/> Weight of qualitative evidence assessed using cerQUAL or other methods</p> <p><input type="checkbox"/> Some method is used to integrate findings from quantitative and qualitative approaches (e.g. summary of findings table) to determine conclusions and implications?</p>	<p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> Partially</p> <p><input type="checkbox"/> No</p> <p><i>Coding guide:</i> <i>YES: All are reported.</i> <i>NO: None are reported.</i> <i>PARTIALLY: Only 1, 2 or 3 are reported.</i></p>
<p>Overall - how much confidence do you have in the causal chain used in the review to analyse studies and the type of evidence incorporated to inform the analysis and reporting?</p>	<p><input type="checkbox"/> Low confidence</p> <p><input type="checkbox"/> Medium confidence</p> <p><input type="checkbox"/> High confidence</p>



Notes:

i. Adapted from the Specialist Unit for Review Evidence (SURE) 2018. Questions to assist with the critical appraisal of systematic reviews available at:

https://www.cardiff.ac.uk/_data/assets/pdf_file/0007/1142962/SURE-CA-form-for-SR_2018.pdf

ii. **Risk of bias** is the extent to which bias may be responsible for the findings of a study.

Bias is a systematic error or deviation from the truth in results or inferences. In studies of the effects of social, economic and health care interventions, the main types of bias arise from systematic differences in the groups that are compared (selection bias), the intervention that is provided, or exposure to other factors apart from the intervention of interest (performance bias/contamination), withdrawals or exclusions of people entered into a study (attrition bias) or how outcomes are assessed (detection bias) and reported (reporting bias). Reviews of social science studies may be particularly affected by reporting bias, where a biased subset of all the relevant data and analyses is presented.

Assessments of the risk of bias are sometimes also referred to as assessments of the **validity** or **quality** of a study.

Validity is the extent to which a result (of a measurement or study) is likely to be true.

Quality is a vague notion of the strength or validity of a study, often indicating the extent of control over bias.

Appendix 7: Summary of included systematic reviews

Table 6.1. Moderate and high confidence systematic reviews

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
High confidence reviews (18 in total)								
Diaconu et al., 2021[52]	Journal article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	59	BD5. Pay-for-performance schemes	JAA15. Vaccination coverage (unspecified); JAA01. Full routine immunisation for children; JAA02. BCG; JAA05. DPT3; JAA11. Measles; JAA09. OPV3; IAA1. Community HW motivation, capacity & performance; ICA1. Stockouts; HAD4. Experience and satisfaction with health services	Child; Patients; Health facility; Healthcare workers
Eze, Lawani, & Acharya, 2021[44]	Journal article	Systematic review & Meta-analysis	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	18	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified); JAA13. Vaccination. Timeliness	Child
Gera et al., 2016[53]	Journal article	Systematic review & Meta-analysis	2	Sub-Saharan Africa, South Asia	4	BA1. Formal health worker training and education; BF1. Health system strategic planning	JAA11. Measles; JAA05. DPT3	Child
Glenton et al., 2011[54]	Journal article	Systematic review & Meta-analysis	7	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Eastern Europe and Central Asia, North America, Western Europe	12	AA2. Short-term sensitization and education campaigns; BB7. Home visits; BB4. Promoting outreach to vaccine-hesitant groups; BC1. National/sub-national immunisation days; BB7. Home visits	JAA01. Full routine immunisation for children	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Jain et al., 2022[41, 42] ⁴	Journal article	Systematic review & Meta-analysis	3	Sub-Saharan Africa, South Asia, Latin America & the Caribbean	61	F. Multicomponent; AB1. Material/ monetary incentives for caregivers; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; CA1. Faith-based outreach/outreach using local leaders; DA1. Collaborating with whole community; BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); DA1. Collaborating with whole community; BD5. Pay-for-performance schemes; BF1. Health system strategic planning	JAA01. Full routine immunisation for children; JAA05. DPT3; JAA11. Measles; JAA13. Vaccination. Timeliness; JAA12. No vs. partial routine immunisation; JAA02. BCG; JAA03. DPT1; JAA04. DPT2; JAA06. OPV0; JAA07. OPV1; JAA08. OPV2; JAA09. OPV3; JAA14. Drop out rate for multidose vaccines; HAA1. Knowledge about immunisation; HAA2. Attitudes about immunisation; HAD5. Vaccination health card availability/ retention; HAD4. Experience and satisfaction with health services; IAB3. Formal HW motivation, capacity & performance	Child; Caregivers; Healthcare workers
Johri et al., 2015[55]	Journal Article	Systematic review & Meta-analysis	3	Sub-Saharan Africa, South Asia, Latin America & the Caribbean	11	F. Multicomponent; AA2. Short-term sensitization and education campaigns; AB. Incentives & motivation	JAA15. Vaccination coverage (unspecified)	Child
Kaufman et al., 2018[56]	Journal article	Systematic review & Meta-analysis	4	South Asia, East Asia and Pacific, North America, Western Europe	10	AA2. Short-term sensitization and education campaigns	JAA12. No vs. partial routine immunisation;	Child

⁴ Our search timeframe was up to and including 2021, thus Jain et al. (2022) may appear to be at odds with this. However, Jain et al. (2021) was identified through the grey literature search but was subsequently published in 2022, hence we cite it as Jain et al. (2022) throughout.

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Lagarde & Palmer, 2009[57]	Journal article	Systematic review	3	South Asia, East Asia and Pacific, Latin America & the Caribbean	3	BF4. Health system financing	JAA01. Full routine immunisation for children	Child
Lagarde, Haines, & Palmer, 2009[58]	Journal article	Systematic review	2	Sub-Saharan Africa, Latin America & the Caribbean	10	AB1. Material/ monetary incentives for caregivers	JAA02. BCG; JAA11. Measles; JAA03. DPT1; JAA05. DPT3; JAA01. Full routine immunisation for children	Child
Linde et al., 2009[59]	Journal article	Systematic review & Meta-analysis	2	Sub-Saharan Africa, Middle East & North Africa	38	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified)	Child
Mekonnen et al., 2019[60]	Journal Article	Systematic review & Meta-analysis	3	Sub-Saharan Africa, Latin America & the Caribbean, North America	10	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified)	Child
Molina et al., 2016[61]	Published report	Systematic review & Meta-analysis	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	15	DA1. Collaborating with whole community; AA2. Short-term sensitization and education campaigns; DA1. Collaborating with whole community	JAA15. Vaccination coverage (unspecified)	Child
Odendaal et al., 2018[62]	Journal article	Systematic review	2	East Asia and Pacific, Latin America & the Caribbean	2	BF4. Health system financing	JAA15. Vaccination coverage (unspecified); ICA1. Stockouts	Child; Health facility

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Oyo-Ita et al., 2016[63]	Journal article	Systematic review & Meta-analysis	4	Sub-Saharan Africa, South Asia, Latin America & the Caribbean, Eastern Europe and Central Asia	14	AA1. Sustained sensitization and education campaigns; AA2. Short-term sensitization and education campaigns; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; BA1. Formal health worker training and education; BF1. Health system strategic planning; AB1. Material/ monetary incentives for caregivers; BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc); AB1. Material/ monetary incentives for caregivers; BB7. Home visits; BF1. Health system strategic planning	JAA05. DPT3; JAA01. Full routine immunisation for children; JAA11. Measles; JAA12. No vs. partial routine immunisation; JAA13. Vaccination Timeliness; JAA02. BCG; JAA03. DPT1; JAA09. OPV3	Child
Palmer et al., 2020[64]	Journal article	Systematic review & Meta-analysis	6	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Eastern Europe and Central Asia, North America	27	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; AB3. Automated voice messages to caregivers	JAA15. Vaccination coverage (unspecified); JAA13. Vaccination Timeliness	Child
Saeterdal et al., 2014[65]	Journal Article	Systematic review	1	South Asia	2	AA2. Short-term sensitization and education campaigns	HAA1. Knowledge about immunisation; JAA15. Vaccination coverage (unspecified); JAA11. Measles; JAA05. DPT3; JAA09. OPV3; HAA2. Attitudes about immunisation; HAB2. Household norms & decision-making	Caregivers; Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Willey et al., 2013[66]	Published report	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	12	BA1. Formal health worker training and education; BF1. Health system strategic planning	JAA15. Vaccination coverage (unspecified); JAA11. Measles	Child
Witter et al., 2012[67]	Journal article	Systematic review	2	Sub-Saharan Africa, East Asia and Pacific	9	BD5. Pay-for-performance schemes	JAA15. Vaccination coverage (unspecified)	Child
Medium confidence reviews (6 in total)								
Atkinson et al., 2019[68]	Journal article	Systematic review & Meta-analysis	4	Sub-Saharan Africa, Latin America & the Caribbean, Middle East & North Africa, North America	12	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA01. Full routine immunisation for children	Child
Bassani et al., 2013[69]	Journal article	Systematic review & Meta-analysis	3	Sub-Saharan Africa, South Asia, Latin America & the Caribbean	25	AB1. Material/ monetary incentives for caregivers	JAA15. Vaccination coverage (unspecified); JAA01. Full routine immunisation for children	Child
Chutiyami, Wyver, & Amin, 2019[70]	Journal article	Systematic review & Meta-analysis	7	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa, North America, Western Europe	32	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified); HAA1. Knowledge about immunisation	Child; Caregivers
Desai et al., 2020[71]	Journal article	Systematic review	1	South Asia	99	DA2. Collaborating with selected community groups and networks	JAA15. Vaccination coverage (unspecified)	Child
Gilmore & McAuliffe 2013[72]	Journal Article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	17	AA2. Short-term sensitization and education campaigns	JAA01. Full routine immunisation for children; JAA15. Vaccination coverage (unspecified)	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Lukusa et al., 2018[73]	Journal Article	Systematic review & Meta-analysis	1	South Asia	6	AA2. Short-term sensitization and education campaigns	JAA15. Vaccination coverage (unspecified); JAA05. DPT3	Child

Table 6.2. Low confidence systematic reviews

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Baequni, 2012[74]	Journal article	Systematic review & Meta-analysis	2	South Asia, East Asia and Pacific	4	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified)	Child
Batt, Fox-Rushby, & Castillo-Riquelme, 2004[75]	Journal Article	Systematic review	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa	34	F. Multicomponent	JAA01. Full routine immunisation for children	Child
Bright et al., 2017[76]	Journal article	Systematic review	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa	57	BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); AB1. Material/monetary incentives for caregivers; BB7. Home visits; BF1. Health system strategic planning; BD5. Pay-for-performance schemes; AA2. Short-term sensitization and education campaigns; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; DA2. Collaborating with selected community groups and networks; BD4. Written or pictorial messages (SMS, stickers, flyers etc.) to health workers; F. Multicomponent	JAA15. Vaccination coverage (unspecified)	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Crocker-Buque et al., 2017[77]	Journal article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	20	F. Multicomponent; BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; AA2. Short-term sensitization and education campaigns; AB1. Material/monetary incentives for caregivers	JAA15. Vaccination coverage (unspecified)	Child
Das, Gopalan, & Chandramohan, 2016[78]	Journal article	Systematic review	3	Sub-Saharan Africa, East Asia and Pacific, Middle East & North Africa	8	BD5. Pay-for-performance schemes	ICA1. Stockouts	Health facility
de Cock et al., 2020[79]	Journal Article	Systematic review	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, North America, Western Europe	28	BG1. New HMIS/Dashboard systems (incl. improved data collection)	JAA15. Vaccination coverage (unspecified)	Child
de Souza Cruz et al., 2017[80]	Journal Article	Systematic review	3	Sub-Saharan Africa, South Asia, Latin America & the Caribbean	17	AB1. Material/monetary incentives for caregivers	JAA15. Vaccination coverage (unspecified); JAA01. Full routine immunisation for children	Child
Deardorff et al., 2018[81]	Journal article	Systematic review & Meta-analysis	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa	28	AA2. Short-term sensitization and education campaigns; AA3. Public information campaigns; CA1. Faith-based outreach/outreach using local leaders; BC1. National/sub-national immunisation days	JAA15. Vaccination coverage (unspecified); JAA11. Measles	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Freeman et al., 2017[82]	Journal article	Systematic review	8	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa, Eastern Europe and Central Asia, North America, Western Europe	489	BB2. Community health worker involvement in planning & monitoring; BB7. Home visits; CA1. Faith-based outreach/outreach using local leaders; AA3. Public information campaigns; AA2. Short-term sensitization and education campaigns; AB1. Material/ monetary incentives for caregivers; BC1. National/sub-national immunisation days; BB7. Home visits	JAA15. Vaccination coverage (unspecified); JAA01. Full routine immunisation for children	Child
Giedion, Andrés Alfonso, & Díaz, 2013[83]	Published report	Systematic review	6	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa, Eastern Europe and Central Asia	105	AB5. Changes to health system user fees	JAA01. Full routine immunisation for children	Child
Harvey et al., 2015[84]	Journal article	Systematic review & Meta-analysis	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, North America, Western Europe	28	AA2. Short-term sensitization and education campaigns; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified)	Child
Iwu et al., 2019[85]	Journal Article	Systematic review	3	Sub-Saharan Africa, South Asia, North America	4	BF1. Health system strategic planning; BG1. New HMIS/Dashboard systems (incl. improved data collection); BG2. Capacity building (e.g., training) for existing systems	ICA1. Stockouts; IBA1. Immunisation data collection (quality, completeness); HAD2. Actual cost of vaccinating	Health facility; Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Jarrett et al., 2015[86]	Journal Article	Systematic review	4	Sub-Saharan Africa, South Asia, Eastern Europe and Central Asia, Western Europe	13	CA1. Faith-based outreach/outreach using local leaders; F. Multicomponent; AA2. Short-term sensitization and education campaigns; BA1. Formal health worker training and education; AB1. Material/monetary incentives for caregivers; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA09. OPV3; JAA15. Vaccination coverage (unspecified); JAA05. DPT3	Child
Karageorgos et al., 2019[87]	Journal Article	Systematic review	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa	98	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified)	Child
Kim, Patel, & Hinman, 2017[88]	Journal Article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	26	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; BG1. New HMIS/Dashboard systems (incl. improved data collection); AA2. Short-term sensitization and education campaigns	JAA15. Vaccination coverage (unspecified); JAA13. Vacc. Timeliness; IBA1. Immunisation data collection (quality, completeness); HAC1. Readiness to vaccinate	Child; Healthcare workers; Caregivers
Loevinsohn & Harding, 2004[89]	Discussion paper	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	10	BF4. Health system financing	JAA15. Vaccination coverage (unspecified);	Child;
Munk et al., 2019[37]	Journal Article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	14	F. Multicomponent	JAA15. Vaccination coverage (unspecified); HAD2. Actual cost of vaccinating	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Mureed et al., 2015[90]	Journal Article	Systematic review & Meta-analysis	3	Sub-Saharan Africa, South Asia, Middle East & North Africa	10	F. Multicomponent	JAA15. Vaccination coverage (unspecified); JAA05. DPT3; JAA09. OPV3; JAA11. Measles; JAA01. Full routine immunisation for children	Child
Naugle & Hornik, 2014[91]	Journal Article	Systematic review	6	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa, Eastern Europe and Central Asia	106	AA3. Public information campaigns	JAA15. Vaccination coverage (unspecified)	Child
Nelson et al., 2016[92]	Journal Article	Systematic review	6	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa, Eastern Europe and Central Asia	15	F. Multicomponent; BF1. Health system strategic planning	JAA01. Full routine immunisation for children; JAA05. DPT3	Child
Nutman, McKee, & Khoshnood, 2013[93]	Journal Article	Systematic review	1	Sub-Saharan Africa	21	BF1. Health system strategic planning	JAA15. Vaccination coverage (unspecified)	Child
Oliver-Williams et al., 2017[94]	Journal article	Systematic review	3	Sub-Saharan Africa, South Asia, East Asia and Pacific	21	AB3. Automated voice messages to caregivers; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers	JAA15. Vaccination coverage (unspecified)	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Omoniyi & Williams, 2020[38]	Journal article	Systematic review	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa	27	AA2. Short-term sensitization and education campaigns; CA1. Faith-based outreach/outreach using local leaders; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; AB1. Material/monetary incentives for caregivers; BB7. Home visits; CA1. Faith-based outreach/outreach using local leaders; BA1. Formal health worker training and education; BF1. Health system strategic planning; F. Multicomponent	JAA15. Vaccination coverage (unspecified)	Child
Onwuchekwa, Verdonck, & Marchal, 2021[43]	Journal Article	Systematic review	1	Sub-Saharan Africa	9	AB1. Material/monetary incentives for caregivers	JAA15. Vaccination coverage (unspecified)	Child
Owusu-Addo & Cross, 2014[95]	Journal article	Systematic review	2	Sub-Saharan Africa, Latin America & the Caribbean	16	AB1. Material/monetary incentives for caregivers	JAA15. Vaccination coverage (unspecified)	Child
Ozawa, Yemeke, & Thompson, 2018[96]	Journal article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	42	F. Multicomponent	0	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Pal, Goodyear-Smith, & Exeter, 2016[97]	Journal article	Systematic review	2	South Asia, East Asia and Pacific	14	AA2. Short-term sensitization and education campaigns; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; BA1. Formal health worker training and education; DA1. Collaborating with whole community; AB1. Material/ monetary incentives for caregivers	JAA05. DPT3; JAA03. DPT1	Child
Parrado-Jiménez, 2013[98]	Unpublished research	Systematic review	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa	21	BD5. Pay-for-performance schemes	JAA01. Full routine immunisation for children	Child
Pegurri, Fox-Rushby, & Damian, 2005[99]	Journal article	Systematic review	3	Sub-Saharan Africa, South Asia, Latin America & the Caribbean	60	F. Multicomponent	JAA15. Vaccination coverage (unspecified)	Child
Pinzón-Flórez et al., 2015[100]	Journal article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	19	AA2. Short-term sensitization and education campaigns	JAA01. Full routine immunisation for children; HAD5. Vaccination health card availability/ retention	Child
Rahman et al., 2013[101]	Journal Article	Systematic review & Meta-analysis	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	13	BB7. Home visits	JAA01. Full routine immunisation for children	Child
Ranganathan & Lagarde, 2012[102]	Journal Article	Systematic review	3	Sub-Saharan Africa, South Asia, Latin America & the Caribbean	18	AB1. Material/ monetary incentives for caregivers	JAA15. Vaccination coverage (unspecified)	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Ryman, Dietz, & Cairns, 2008[103]	Journal Article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	25	AA2. Short-term sensitization and education campaigns; BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); BB7. Home visits; AA1. Sustained sensitization and education campaigns; AA3. Public information campaigns; AA1. Sustained sensitization and education campaigns; BF1. Health system strategic planning; AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; BF4. Health system financing; BA1. Formal health worker training and education; BD1. Material/monetary incentives for health workers	JAA15. Vaccination coverage (unspecified); JAA13. Vacc. Timeliness	Child
Shea, Andersson, & Henry, 2009[104]	Journal Article	Systematic review	5	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean, Middle East & North Africa	8	AA3. Public information campaigns; F. Multicomponent; BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); AA2. Short-term sensitization and education campaigns; BD1. Material/monetary incentives for health workers; BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); BB7. Home visits; AA. Information & education	JAA01. Full routine immunisation for children; HAA1. Knowledge about immunisation; JAA15. Vaccination coverage (unspecified); JAA11. Measles; HAD2. Actual cost of vaccinating	Child; Caregivers
Smith et al., 2018[105]	Journal Article	Systematic review	1	Sub-Saharan Africa	28	BF1. Health system strategic planning	JAA15. Vaccination coverage (unspecified)	Child

Authors & Year	Source	Type of review	Geographic focus		No. primary studies	Types of intervention included	Types of outcomes included	Population level analysed
			No. of regions	Regions				
Watterson, Walsh, & Madeka, 2015[106]	Journal Article	Systematic review	2	Sub-Saharan Africa, East Asia and Pacific	10	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; BG1. New HMIS/Dashboard systems (incl. improved data collection); AB1. Material/ monetary incentives for caregivers; AB3. Automated voice messages to caregivers; AA2. Short-term sensitization and education campaigns	JAA13. Vacc. Timeliness; HAC1. Readiness to vaccinate; JAA11. Measles	Child; Caregivers
Yuan et al., 2014[107]	Journal Article	Systematic review	4	Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America & the Caribbean	22	BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); AA3. Public information campaigns; BF1. Health system strategic planning	JAA11. Measles	Child
Yunusa et al., 2021[108]	Journal article in progress	Systematic review & Meta-analysis	3	Sub-Saharan Africa, South Asia, Latin America & the Caribbean	11	AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers; AB3. Automated voice messages to caregivers	JAA01. Full routine immunisation for children; JAA15. Vaccination coverage (unspecified); JAA13. Vacc. Timeliness	Child

Appendix 8: Risk of bias of included systematic reviews

Sr. No.	Included systematic review	Confidence rating in RoR	Confidence rating in EGM	Type of synthesis	Reasons, if confidence rating differs between RoR and EGM
High confidence studies (18 in total)					
1	Diaconu et al., 2021[52]	High	NA [#]	Range of ES + DC	
2	Eze et al., 2021[44]	High	NA	MR + MA + VC direction of effect	
3	Gera et al., 2016[53]	High	High	MA + NS	
4	Glenton et al., 2011[54]	High	NA	MA + NS	
5	Jain et al., 2022[41, 42]	High	NA	MR + MA + TS	
6	Johri et al., 2015[55]	High	Medium	MR + MA	Upgraded to high confidence: EGM coders marked section A as low confidence because the search was not comprehensive. RoR coders marked section A as high confidence as search included studies from other published reviews dating back to 1996. However, we acknowledge some limitations of the search, but these were not sufficient for a low confidence rating.
7	Kaufman et al., 2018[56]	High	High	MA	
8	Lagarde et al., 2009[58]	High	High	NS	
9	Lagarde & Palmer, 2009[57] (update cited as Odendaal et al., 2018[62])	High	High	DC + NS	
10	Linde et al., 2009[59]	High	High	MA + NS	
11	Mekonnen et al., 2019[60]	High	Medium	MR + MA	Upgraded to high confidence: No obvious difference between grading of RoR and EGM coders, however, mitigating factors (e.g., Kappa statistics and Grade assessment) which influenced the overall assessment to high confidence. We acknowledge the search was restricted to English only and unit of analysis error was not reported but this is not sufficient to justify a medium confidence rating.
12	Molina et al., 2016[61]	High	High	MA + DC + NS	

Sr. No.	Included systematic review	Confidence rating in RoR	Confidence rating in EGM	Type of synthesis	Reasons, if confidence rating differs between RoR and EGM
13	Odendaal et al., 2018[62]	High	High	DC + NS	
14	Oyo-Ita et al., 2016[63]	High	High	MA + DC	
15	Palmer et al., 2020[64]	High	NA	MA + DC + NS	
16	Saeterdal et al., 2014[65]	High	High~	DC + NS	
17	Willey et al., 2012[66]	High	High	NS + NS	
18	Witter et al., 2012[67] (update cited as Diaconu et al., 2021[52])	High	High	DC + NS	
Medium confidence studies (6 in total)					
19	Atkinson et al., 2019[68]	Medium	Medium	MA	
20	Bassani et al., 2013[69]	Medium	Medium	MA	
21	Chutiyami et al., 2019[70]	Medium	Low	MA + Range of ES + VC statistical significance + VC direction of effect + DC + NS	Upgraded to medium confidence: EGM coders marked section A as low confidence as search was partial, search period not documented and no sufficient criteria to assess study quality. RoR coders marked section A as medium because included studies dated back to 1984 and sufficient criteria were used to assess quality while acknowledging some search limitations. EGM coders marked section B as low. RoR coders upgraded this to medium because 20% of studies were randomly extracted by two independent researchers. Also, section B3 was upgraded as heterogeneity was acknowledged and statistical tests to demonstrate heterogeneity were performed. Unit of analysis error was not documented.
22	Desai et al., 2020[71]	Medium	NA	NS + TS	
23	Gilmore & McAuliffe, 2013[72]	Medium	Medium	Range of ES + NS	
24	Lukusa et al., 2018[73]	Medium	Medium	MA	

Sr. No.	Included systematic review	Confidence rating in RoR	Confidence rating in EGM	Type of synthesis	Reasons, if confidence rating differs between RoR and EGM
Low confidence studies (38 in total):					
25	Baequni, 2012[74]	Low	Low	MA	
26	Batt et al., 2004[75]	Low	Low	DC	
27	Bright et al., 2017[76]	Low	Low	VC statistical significance + NS	
28	Crocker-Buque et al., 2017[77]	Low	Low	NS + TS	
29	Das et al., 2016[78]	Low	Low	DC + NS	
30	de Cock et al., 2020[79]	Low	NA	VC direction of effect + NS	
31	de Souza Cruz et al., 2017[80]	Low	Low	NS	
32	Deardorff et al., 2018[81]	Low	Low	MA + DC + NS	
33	Freeman et al., 2017[82]	Low	Low	NS	
34	Giedion et al., 2013[83]	Low	Low	NS	
35	Harvey et al., 2015[84]	Low	Low	MA + Range of ES	
36	Iwu et al., 2019[85]	Low	Low	NS	
37	Jarrett et al., 2015[86]	Low	Low	DC + NS	
38	Karageorgos et al., 2018[87]	Low	Low	NS	
39	Kim et al., 2017[88]	Low	Low	NS	
40	Loevinsohn & Harding, 2004[89]	Low	Low	Range of ES + DC + NS	
41	Munk et al., 2019[37]	Low	Low	Range of ES + DC	
42	Mureed et al., 2015[90]	Low	Low	MA + VC direction of effect	
43	Naugle & Hornik, 2014[91]	Low	Low	VC direction of effect + DC + NS	
44	Nelson et al., 2016[92]	Low	Low	Range of ES + NS	
45	Nutman et al., 2013[93]	Low	Low	Range of ES + VC statistical significance + DC + NS	
46	Oliver-Williams et al., 2017[94]	Low	Low	NS	
47	Omoniyi & Williams, 2020[38]	Low	Low	TS	
48	Onwuchekwa et al., 2021[43]	Low	NA	VC direction of effect + NS + TS	
49	Owusu-Addo & Cross, 2014[95]	Low	Low	NS	

Sr. No.	Included systematic review	Confidence rating in RoR	Confidence rating in EGM	Type of synthesis	Reasons, if confidence rating differs between RoR and EGM
50	Ozawa et al., 2018[96]	Low	Low	DC	
51	Pal et al., 2016[97]	Low	Low	NS	
52	Parrado-Jiménez, 2013[98]	Low	Low	VC statistical significance & direction of effect	
53	Pegurri et al., 2005[99]	Low	Low	DC	
54	Pinzón-Flórez et al., 2015[100]	Low	NA	NS	
55	Rahman et al., 2013[101]	Low	Low	MA + NS	
56	Ranganathan & Lagarde, 2012[102]	Low	Low	NS	
57	Ryman et al., 2008[103]	Low	Low	NS	
58	Shea et al., 2009[104]	Low	Low	NS	
59	Smith et al., 2018[105]	Low	Low	NS	
60	Watterson et al., 2015[106]	Low	Low	NS	
61	Yuan et al. 2014[107]	Low	Medium	NS	Downgraded to low confidence: Authors did not extract data independently. Additionally had further limitations: A summary of the assessment of each included study for each quality assessment criterion was not reported, unit of analysis error was not reported in spite of including cRCTs.
62	Yunusa et al., 2021[108]	Low	NA	MA + NS	

Notes: ~Saeterdal et al., 2014[65] was mistakenly marked as medium confidence in the earlier draft of the EGM manuscript and online map, but this will be rectified before publication.

#NA in column, confidence rating in EGM: these are the systematic reviews identified through our updated search and were not included in the EGM.

Abbreviations: cRCTs: Cluster randomised controlled trials; DC: Descriptive; EGM: Evidence Gap Maps; ES: Effect sizes; MA: Meta-analysis; MR: Meta regression; NS: Narrative synthesis; RoR: Review of reviews; TS: Thematic synthesis; VC: Vote counting.

Appendix 9: Summary of main findings

Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
A. Caregiver-oriented interventions (1 st tier)	AA. Information & education (2 nd tier)	AA1. Sustained sensitisation and education campaigns (3 rd tier)	1	(Ryman et al., 2008[31])	None	None	None	None (Low confidence evidence)
		AA2. One-time sensitisation and education campaigns (3 rd tier)	12	Kaufman et al., 2018; Gilmore & McAuliffe, 2013; Johri et al., 2015; Lukusa et al., 2018; Oyo-Ita et al., 2016; Saeterdal et al., 2014[6, 8, 9, 11, 12, 32] (Crocker-Buque et al., 2017; Deardorff et al.,	Seven pooled estimates are available from 4 SRs; of which 6 were positive and statistically significant. RR ranged between 1.2 and 1.68.	Most SRs included small number of primary studies and reported favourable effects of AA2 intervention on range of outcomes: DPT3, Measles, Vaccination coverage (unspecified) and other secondary outcomes.	The average RR was 1.38 (95% CI: 1.33 to 1.44). Refer to Figure 2	Positive and statistically significant

Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
				2018; Jarette et al., 2015; Kim et al., 2017; Pinzón-Flórez et al., 2015; Shea et al., 2009[33-38])				
		AA3. Public information campaigns (3 rd tier)	3	(Naugle & Hornik, 2014; Shea et al. 2009; Yuan et al. 2014[38-40])	None	None	None	None (Low confidence evidence)

	AB. Incentives & motivation (2 nd tier)	AB1. Material/monetary incentives for caregivers (3 rd tier)	12	Bassani et al., 2013; Lagarde et al., 2009; Oyo-Ita et al., 2016[11, 41, 42] (Bright et al., 2017; Crocker-Buque et al., 2017; de Souza Cruz et al., 2017; Jarette et al., 2015; Onwuchekwa et al., 2021; Omoniyi 2020; Owusu-Addo & Cross, 2014; Pal et al., 2016; Ranganathan & Lagarde, 2012[33, 35, 43-49])	Meta-analysis was done by two SRs, both found statistically insignificant results (RR: 1.05 [0.90, 1.23], SMD ranging from 0.05 to 0.06).	Most outcomes were narratively synthesised with small number of primary studies, suggesting either inconclusive or favourable effect.	MA was not feasible.	Mixed effects
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Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
		AB2. Non-material incentives for caregivers (3 rd tier)	0	NA	None	None	None	No evidence
		AB3. Automated voice messages to caregivers (3 rd tier)	1	(Yunusa et al., 2021[50])	None	None	None	None (Low confidence evidence)

		AB4. Written or pictorial messages (SMS, stickers, flyers etc.) to caregivers (3 rd tier)	13	Atkinson et al., 2019; Chutiyami et al., 2019; Eze et al., 2021; Linde et al., 2019; Mekonnen et al., 2019; Palmer et al., 2020[5, 10, 51-54] (Baequni, 2012; Crocker-Buque et al., 2017; Jarette et al., 2015; Karageorgos et al., 2019; Kim et al., 2017; Omoniyi & Williams, 2020; Yunusa et al., 2021[33, 35, 36, 45, 50, 55, 56])	Meta-analysis was done by all high & medium confidence SRs reporting nine estimates for a range of outcomes, all found positive and statistically significant effects. RR or OR ranged between 1.13 and 3.69.	Intervention was found to be effective in improving Vaccination coverage (unspecified), DPT 3, Full routine immunization, and Vaccination timeliness.	RR of 1.24 (95% CI: 1.11 to 1.36). Refer to Figure 3	Positive and statistically significant
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Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
		AB5. Changes to health system user fees (3 rd tier)	1	(Giedion et al., 2013[57])	None	None	None	None (Low confidence evidence)
B. Health system-oriented (1 st tier)	B.A. Education & training (2 nd tier)	BA1. Formal health worker training and education (3 rd tier)	3	Oyo-Ita et al., 2016[11] (Jarette et al., 2015; Pal et al., 2016[35, 48])	None	Inconclusive effect on outcomes based on single primary study.	None	Limited evidence
		BA2. Community health worker training and education (3 rd tier)	0	None	None	None	None	No evidence

Intervention (1 st , 2 nd , 3 rd tier)		# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**	
				Quantitative findings	Qualitative findings			
	BB. Planning, implementation, monitoring (2 nd tier)	BB1. Formal health worker involvement in planning & monitoring (3 rd tier)	0	None	None	None	None	No evidence
		BB2. Community health worker involvement in planning & monitoring (3 rd tier)	0	None	None	None	None	No evidence
		BB3. Paper-based tracking (3 rd tier)	0	None	None	None	None	No evidence
		BB4. Promoting outreach to vaccine-hesitant groups (3 rd tier)	0	None	None	None	None	No evidence

Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
		BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.) (3 rd tier)	3	Oyo-Ita et al., 2016[11] (Crocker-Buque et al., 2017; Yuan et al., 2014[33, 40])	None	Low certainty favourable effect on the outcome. However, the results are based on a single primary study.	None	Limited evidence
		BB6. Outreach to migrant populations (3 rd tier)	0	None	None	None	None	No evidence
		BB7. Home visits (3 rd tier)	5	Glenton et al., 2011; Oyo-Ita et al., 2016[11, 58] (Freeman et al., 2017; Rahman et al., 2013; Shea et al., 2009[38, 59, 60])	None	Favourable effect of intervention on OPV3, measles and full routine immunisation but the results were based on a single primary study for each outcome.	None	Positive

Intervention (1 st , 2 nd , 3 rd tier)		# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**	
				Quantitative findings	Qualitative findings			
		BB8. Campaigns to vaccinate refugee populations (3 rd tier)	0	None	None	None	None	No evidence
	BC. Supplementary Immunisation Activities (2 nd tier)	BC1. National/sub-national immunisation days (3 rd tier)	2	(Deardoff 2018; Freeman et al., 2017[34, 59])	None	None	None	None (Low confidence evidence)
	BD. Incentives & motivation (2 nd tier)	BD1. Material/monetary incentives for health workers (3 rd tier)	1	(Shea et al., 2009[38])	None	None	None	None (Low confidence evidence)
		BD2. Non-material incentives for health workers (3 rd tier)	0	None	None	None	None	No evidence
		BD3. Automated voice messages to health workers (3 rd tier)	0	None	None	None	None	No evidence

Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
		BD4. Written or pictorial messages (SMS, stickers, flyers etc.) to health workers (3 rd tier)	1	(Bright et al., 2017[43])	None	None	None	None (Low confidence evidence)

		BD5. Pay-for-performance schemes (3 rd tier)	5	Diaconu et al., 2021; Witter et al., 2012[7, 61] (Bright et al., 2017; Das et al., 2016; Parrado-Jiménez, 2013[43, 62, 63])	None	For most vaccination coverage related outcomes, the effect was inconclusive (low certainty evidence). While, for some of the intermediate outcomes it was positive and statistically significant. As per review authors, the aforesaid findings could be because of diversity in these schemes and the differences in outcome measures by the primary studies.	None	Mixed effects
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Intervention (1 st , 2 nd , 3 rd tier)		# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**	
				Quantitative findings	Qualitative findings			
	BE. Infrastructure (2 nd tier)	BE1. Building & upgrading health clinics (3 rd tier)	0	None	None	None	None	No evidence
		BE2. Cold chain infrastructure improvements (3 rd tier)	0	None	None	None	None	None
	BF. Health system governance, policies and financing (2 nd tier)	BF1. Health system strategic planning (3 rd tier)	7	Oyo-Ita et al., 2016[11] (Bright et al., 2017; Nelson et al., 2016; Nutman et al., 2013; Omoniyi & Williams, 2020; Smith et al., 2018; Yuan et al., 2014[40, 43, 45, 64-66])	None	Inconclusive results for most outcomes, from a single primary study.	None	Limited evidence

Intervention (1 st , 2 nd , 3 rd tier)		# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
				Quantitative findings	Qualitative findings		
	BF2. Vaccination guidelines (3 rd tier)	0	None	None	None	None	No evidence
	BF3. Changes to broader governance systems (beyond health systems) (3 rd tier)	0	None	None	None	None	No evidence
	BF4. Health system financing (3 rd tier)	3	Lagarde & Palmer 2009; Odendaal et al., 2018[67, 68] (Loevinsohn & Harding, 2004[69])	None	Inconclusive results for a range of outcomes. The results are based on one or two primary studies for each outcome.	None	Inconclusive

Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
	BG. Technology & mHealth (2 nd tier)	BG1. New HMIS/Dashboard systems (incl. improved data collection) (3 rd tier)	3	(de Cock et al., 2020; Kim et al., 2017; Watterson et al., 2015[36, 70, 71])	None	None	None	None (Low confidence evidence)
		BG2. Capacity building (e.g., training) for existing systems (3 rd tier)	0	None	None	None	None	No evidence
C. Other community member-oriented (1 st tier)	CA. Other community member-oriented (2 nd tier)	CA1. Faith-based outreach/outreach using local leaders (3 rd tier)	1	(Jarrette et al., 2015[35])	None	None	None	None (Low confidence evidence)

Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
D. Community-level (1 st tier)	DA. Communication & dialogue (2 nd tier)	DA1. Collaborating with whole community (3 rd tier)	1	Molina et al., 2016[72]	None	Inconclusive results based on a single primary study.	None	Limited evidence
		DA2. Collaborating with selected community groups and networks (3 rd tier)	1	Desai et al., 2020[73]	None	Small and statistically insignificant result based on two primary studies.	None	Limited evidence
	DB. Tracking & registering (2 nd tier)	DB1. Community tracking and registering (3 rd tier)	0	None	None	None	None	No evidence
E. Policies and institutions (1 st tier)	EA. Education policy and infrastructure (2 nd tier)	EA1. Education policy and infrastructure (3 rd tier)	0	None	None	None	None	No evidence

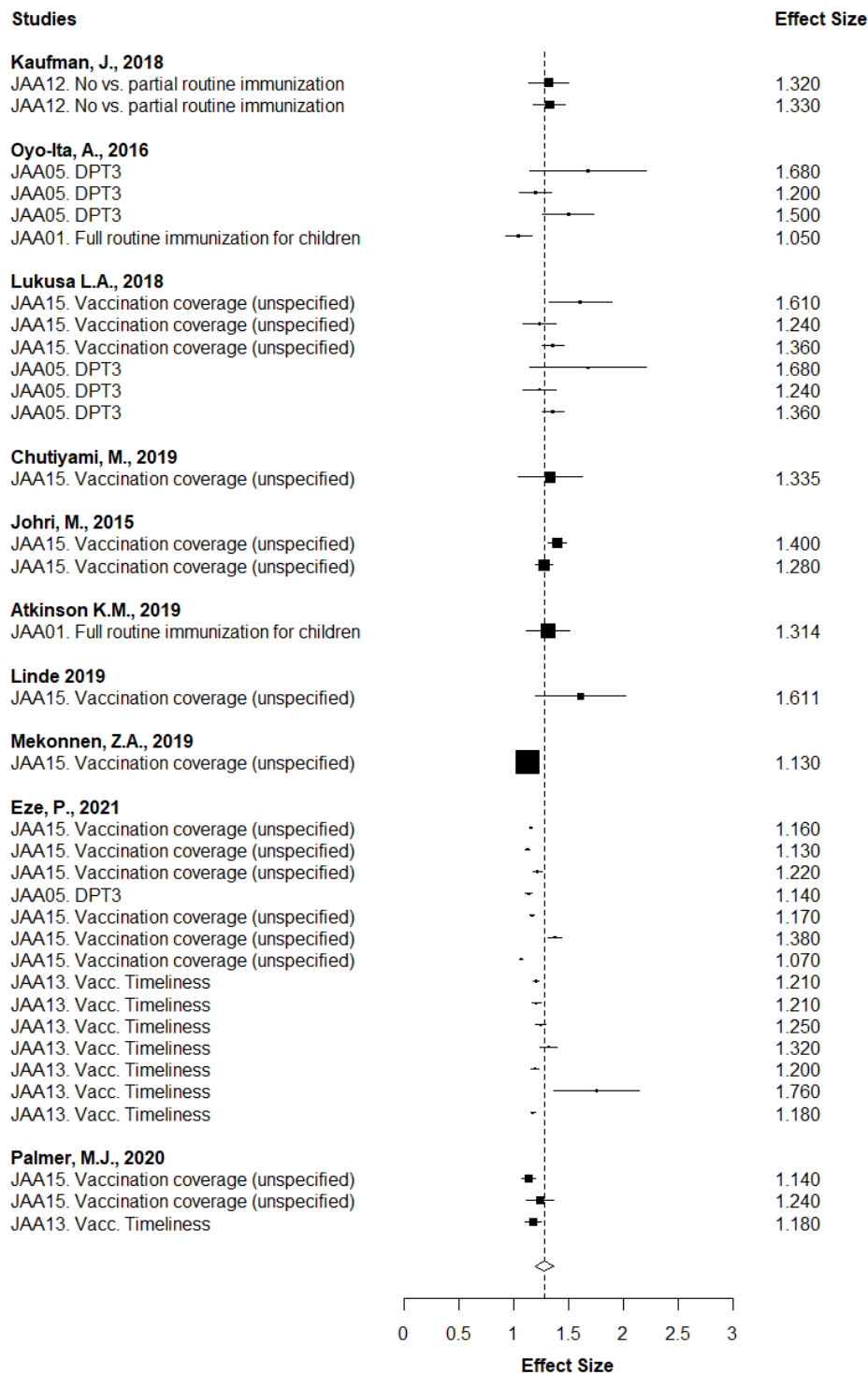
Intervention (1 st , 2 nd , 3 rd tier)			# SRs	SRs (Low confidence SRs in parenthesis)	Evidence as reported in the high & medium confidence SRs		Quantitative findings from RoR	Overall findings**
					Quantitative findings	Qualitative findings		
	EB, Non-health/education infrastructure (2 nd tier)	EB1. Non-health/education infrastructure (e.g., electrification) (3 rd tier)	0	None	None	None	None	No evidence
F. Multicomponent (1 st tier)			1*	Jain et al., 2022[29, 30]	Meta-analysis done on a range of outcomes and found positive and statistically significant effect on most of the outcomes. The SMD ranged between 0.06 and 0.24	None	None	Positive and statistically significant

Notes: *Apart from Jain et al. 2022 there were 25 systematic reviews that assessed the effects of more than one intervention that are not part of this table. Of these reviews, the majority (n = 18) were low confidence SRs and the intervention components were heterogenous. We provide summary of Jain et al. 2022 in this table because it is one of the only included SRs that assessed community engagement interventions. Intervention and outcome codes are taken from Appendix 1.

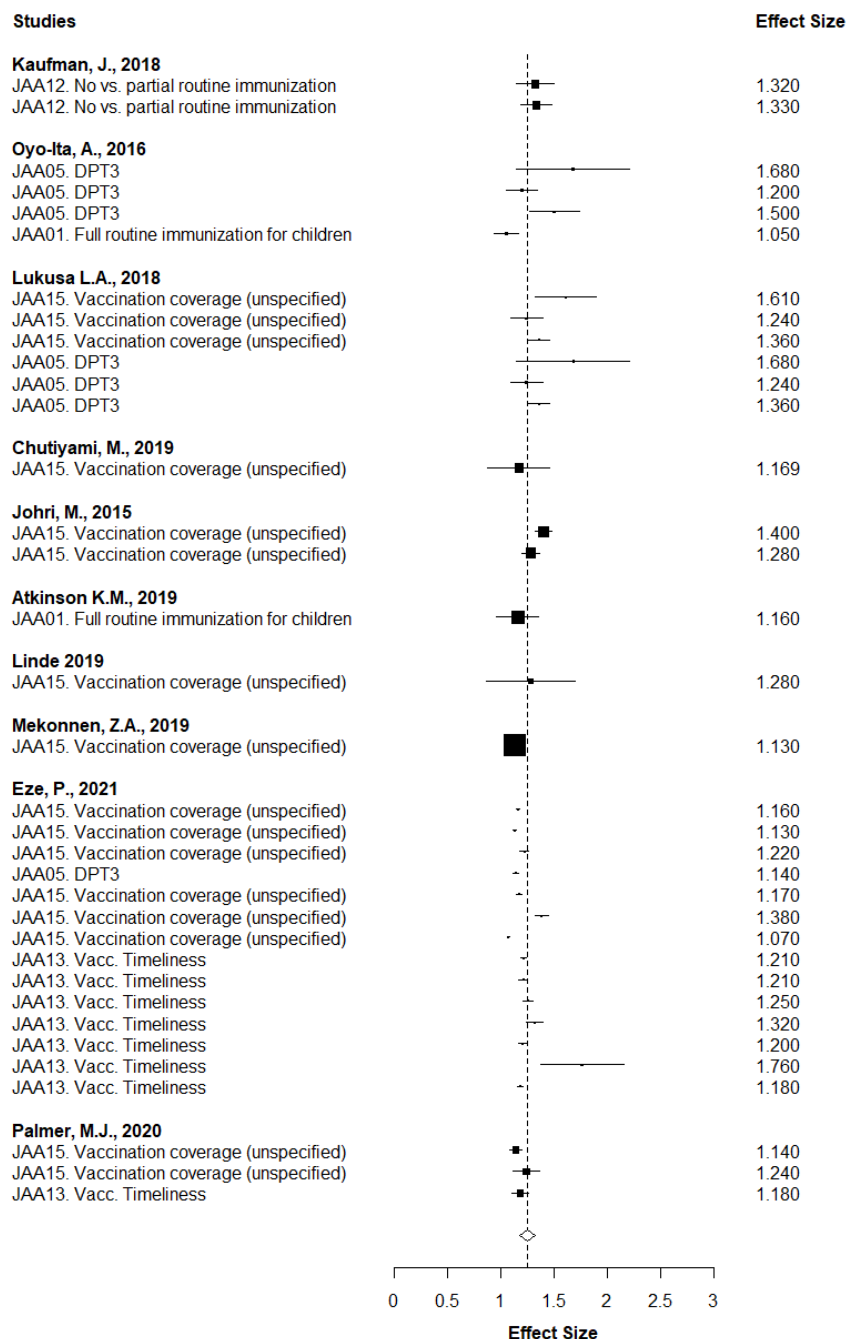
** The last column, 'overall findings' are summarized from evidence as reported in the systematic reviews, qualitative and quantitative findings and quantitative findings from review of reviews (RoR). The current table (in Appendic 9) is the condensed form of Table 2 in main manuscript file.

Appendix 10: RVE analysis – 1st tier synthesis

Figure A8.1: RVE of all interventions under Type A, 1st tier, mean baseline coverage values

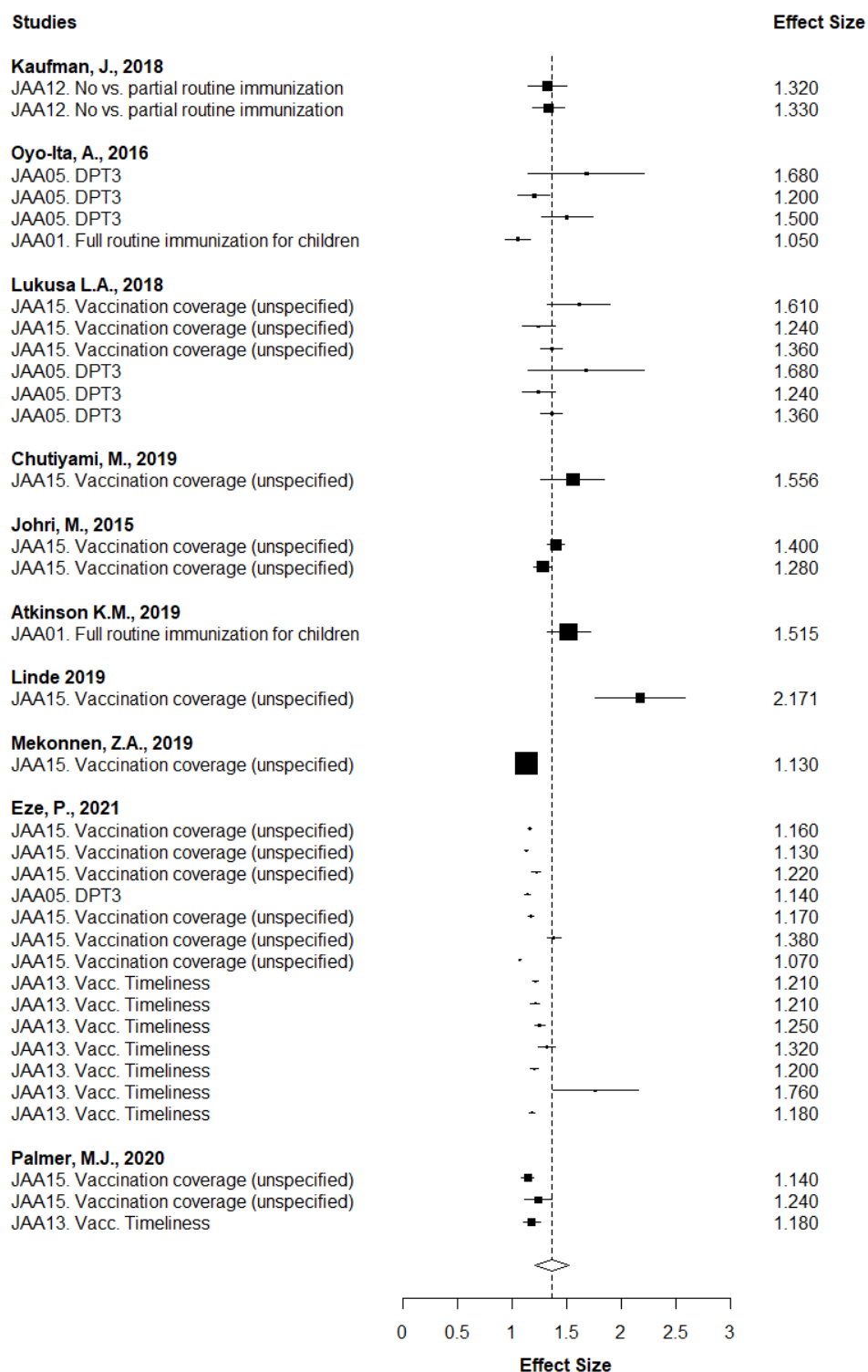


Notes: Drawing on k = 10 and 35 effect sizes.

Additional RVE analysis – 1st tier synthesis**Figure A8.2: RVE of all interventions under Type A, 1st tier, one standard deviation above the mean (baseline coverage rate of 70%)**

Notes: Drawing on k = 10 and 35 effect sizes.

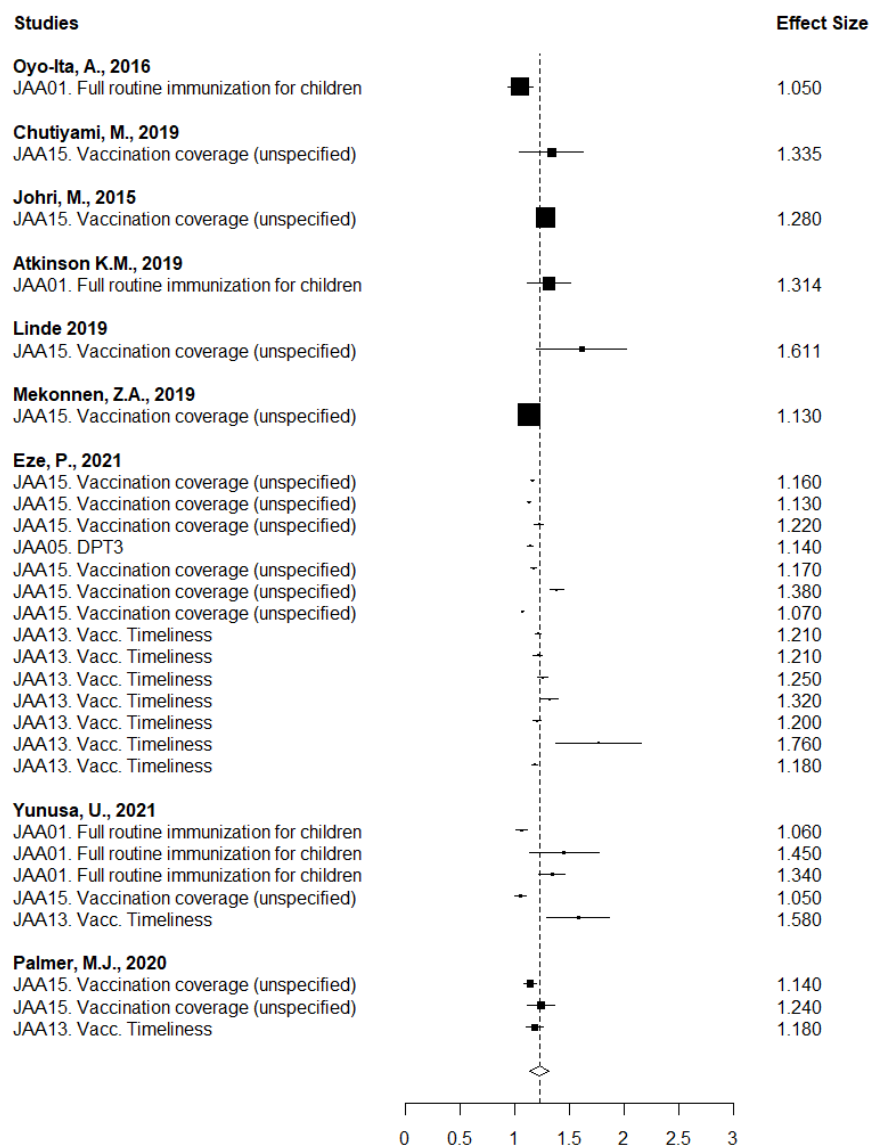
Figure A8.3: RVE of all interventions under Type A, 1st tier, one standard deviation below the mean (baseline coverage rate of 26%)



Notes: Drawing on k = 10 and 35 effect sizes.

Appendix 11: RVE analysis – 2nd tier synthesis

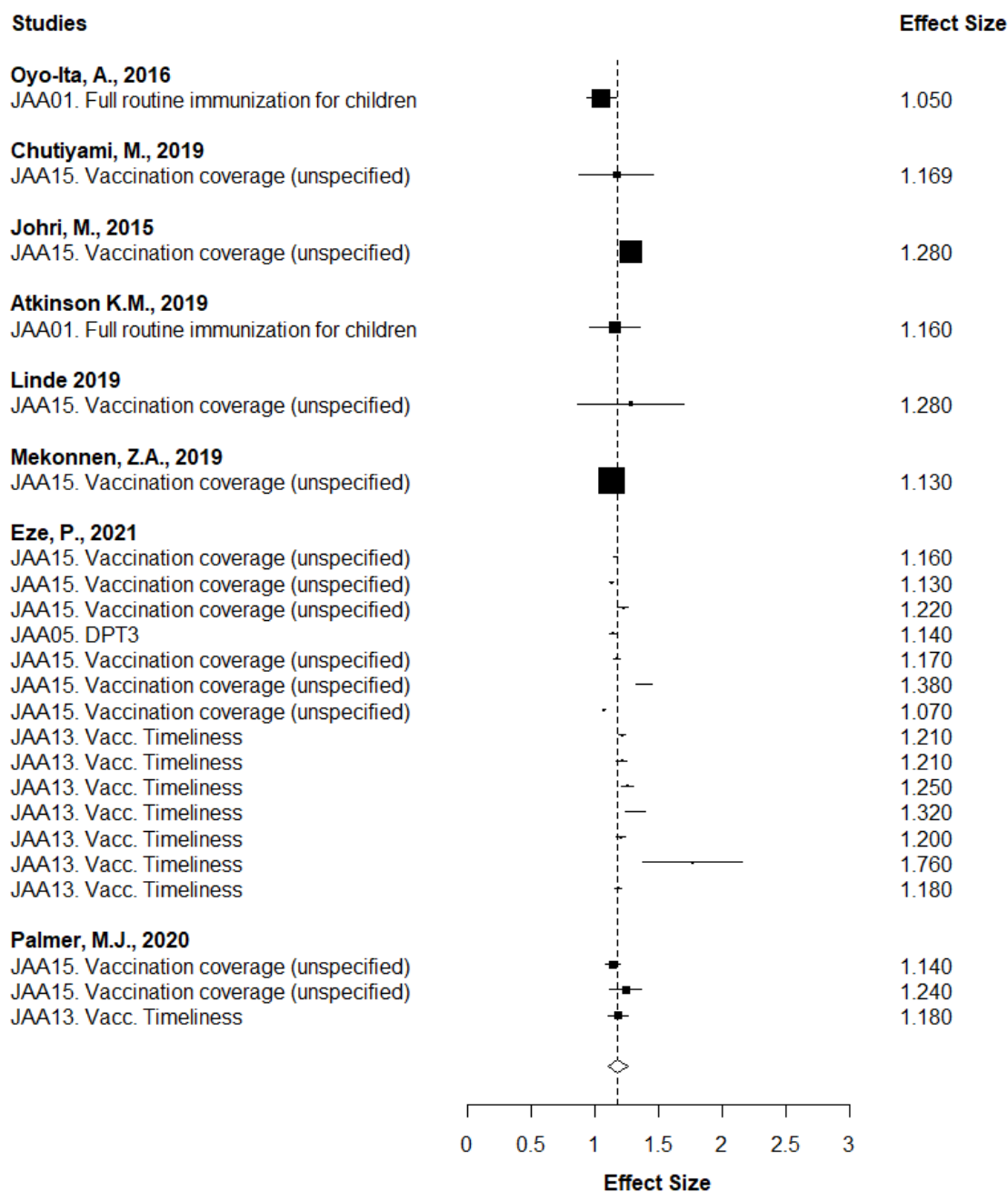
Figure 9.1: RVE of all interventions under Type AB, 2nd tier, mean baseline coverage values



Notes: Drawing on k = 9 and 28 effect sizes.

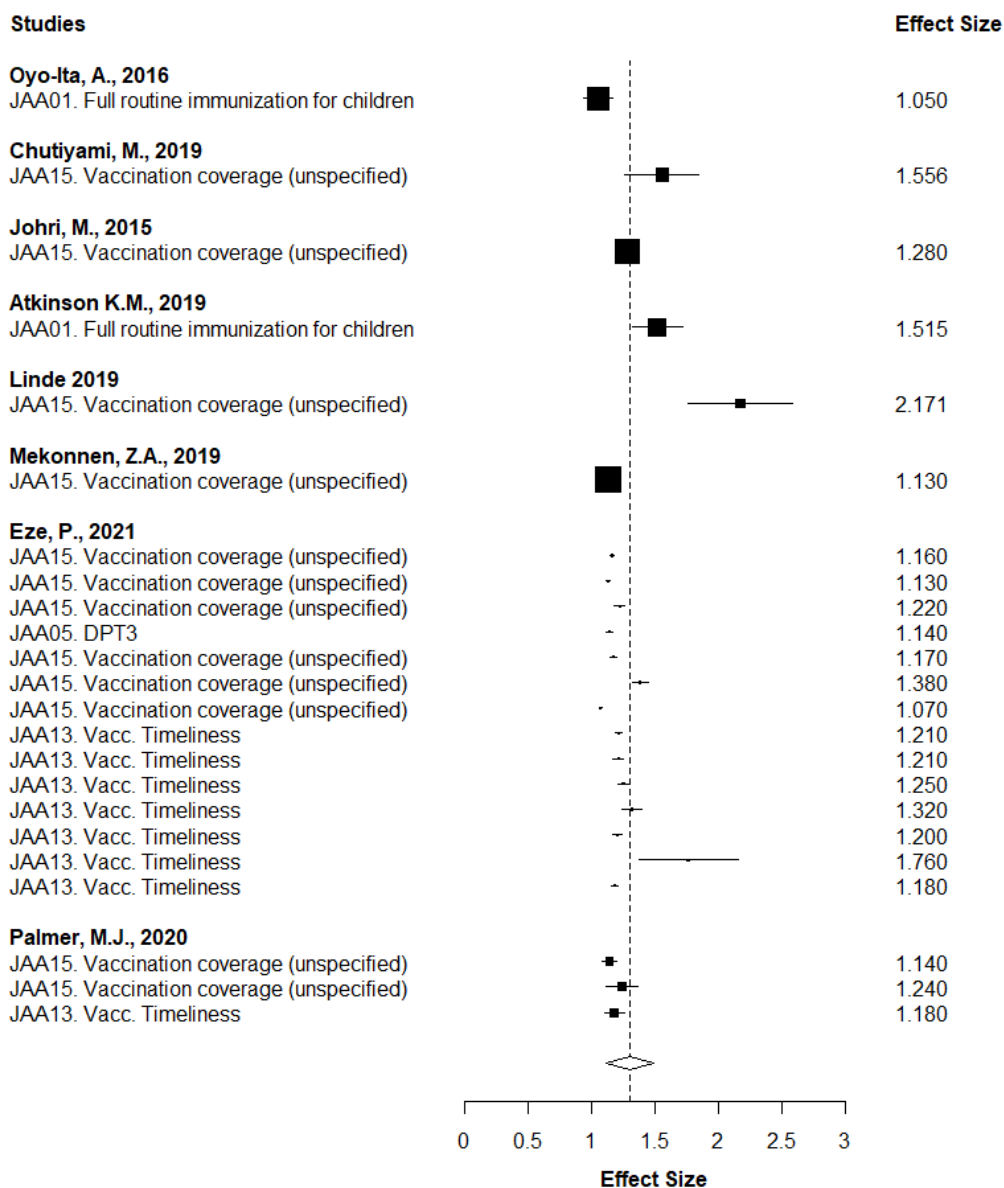
Additional RVE analysis – 2nd tier synthesis

Figure A9.2: RVE of all interventions under Type AB, 2nd tier, one standard deviation above the mean (baseline coverage rate of 70%)



Notes: Drawing on k = 8 and 23 effect sizes.

Figure A9.3: RVE of all interventions under Type AB, 2nd tier, one standard deviation below the mean (baseline coverage rate of 26%)



Notes: Drawing on k = 8 and 23 effect sizes.

Appendix 12: Health-systems oriented interventions

This section synthesises the high and medium confidence evidence in relation to health-systems oriented interventions (B). We have insufficient quantitative data for health-systems oriented interventions (B), hence, this section adopts a narrative approach. We begin with a summary of what we know about health-systems oriented interventions (B). The two tables below are based on 9 reviews that discuss health-systems oriented intervention categories (B), 2 of these reviews[54, 63] are captured in Table 11 above already as they are discussing complementary interventions spanning the broader categories caregiver (A) and health-systems oriented interventions (B).

Table 12 lists six reviews presenting a mixed picture in terms of intervention categories, outcomes and findings. 2 reviews each examine home visits (BB7), pay-for-performance schemes (BD5) and health system financing (BF4) in more depth. As with caregiver-oriented intervention categories (A), the evidence is based on very small study numbers. E.g., for home visits (BB7), two reviews[54, 63], find favourable effects on OPV3, measles and full routine immunisation for children. Diaconu et al.[52] and Witter et al.[67] examine pay-for-performance schemes (BD5) finding mixed results. E.g., Diaconu et al. (2021)[52] drawing on 2 to 9 studies (all low certainty) across a wide range of outcomes suggest that pay-for-performance schemes (BD5) are effective in terms of improving full routine immunisation for children, measles coverage and community health worker motivation with the remaining results being inconclusive. Witter et al. (2012)[67] only investigate the link between pay-for-performance schemes (BD5) and vaccination coverage more broadly finding inconclusive results drawing on 2 low certainty studies. Caution is required regarding over-interpreting the results of pay-for-performance schemes. A review of payment-by-results schemes for health interventions in L&MICs[109] argues that these schemes typically focus on short-term output measures such as vaccination coverage that obscure the bigger picture, e.g., the need to reform the wider health system to ensure better delivery of immunisation interventions, and not necessarily provide a long-term measure of the effectiveness of a programme. Lagarde & Palmer (2009)[57] and Odendaal et al. (2018)[62] examine health system financing (BF4) finding inconclusive results, again working with a small number of studies and across heterogenous outcomes. The high and medium confidence evidence for the remaining health-systems oriented interventions (B) is difficult to unpack systematically as we only have 1 review each for formal health worker training and education (BA1), outreach to vulnerable populations (hard-to-reach, SES, caste, etc.) (BB5) and health system strategic planning (BF1). In summary, we have no evidence on the majority of the 3rd tier health-systems oriented interventions (B) except for formal health worker training and education (BA1), promoting outreach to vaccine-hesitant groups (BB4) (in combination with national/sub-national immunisation days (BC1), see Table 13), outreach to vulnerable populations (hard-to-reach, SES, caste, etc.) (BB5), home visits (BB7), pay-for-performance schemes (BD5), health system strategic planning (BF1) and health system financing (BF4).

Table A10.1: B. Health-systems oriented interventions (all high confidence systematic reviews) – one intervention only

Systematic review	Intervention, 3 rd tier level	Outcome	Finding
Oyo-Ita et al., 2016[63]	BA1. Formal health worker training and education	JAA05. DPT3; JAA09. OPV3	<ul style="list-style-type: none"> DPT3: inconclusive effect, low certainty (k = 1 study) [p.16] OPV3: inconclusive effect, low certainty (k = 1 study) [p.17]
Oyo-Ita et al., 2016[63]	BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.)	JAA01. Full routine immunization for children	<ul style="list-style-type: none"> Full routine immunization for children: favourable effect, low certainty (k = 1 study) [p.17]
Oyo-Ita et al., 2016[63]	BB7. Home visits	JAA09. OPV3; JAA11. Measles	<ul style="list-style-type: none"> OPV3: favourable effect, low certainty (k = 1 study) [p.18] Measles: favourable effect, low certainty (k = 1 study) [p.18]
Glenton et al., 2011[54]	BB7. Home visits	JAA01. Full routine immunization for children	<ul style="list-style-type: none"> Full routine immunization for children: favourable effect (k = 1 study) [p.1049]

Diaconu et al., 2021[52]	BD5. Pay-for-performance schemes	JAA15. Vaccination coverage (unspecified); JAA01. Full routine immunisation for children; JAA02. BCG; JAA05. DPT3; JAA11. Measles; JAA09. OPV3; IAA1. Community HW motivation, capacity & performance; ICA1. Stockouts; HAD4. Experience and satisfaction with health services	<ul style="list-style-type: none"> • Vaccination coverage (unspecified): Inconsistent effects of small magnitude, low certainty evidence (k = 5 studies) [p. 177, 210]. Effective among poorest group for the targeted outcome (k = 2 studies), low certainty evidence, however, not for untargeted outcome, wherein it was very low certainty evidence (k = 1 study) [p.193] • Full immunisation coverage: effective, low certainty evidence (k = 8 studies) [p. 178], however, for targeted measures for provider performance there was inconclusive effects, low certainty evidence (k = 3 studies) [p. 210] • DPT3 coverage: Little or no effects, low certainty evidence for DPT 3 (k = 6 studies) or Pentavalent (k = 3 studies) [p. 178, 210] • Measles coverage: Desirable effects, low certainty evidence (k = 6 studies) [p. 178] • BCG: inconclusive (k = 9 studies) [Appendix 1, 2] • OPV 3 coverage: inconclusive (k = 7 studies) [Appendix 1] • Community health worker motivation, capacity and performance: favourable (k = 8 studies) [Appendix 1, 2] • Stockouts: inconclusive (k = 4 studies) [Appendix 1] • Experience and satisfaction with health services: favourable for overall satisfaction untargeted outcome (k = 4 studies) and inconclusive for targeted outcome (k = 2 studies) [Appendix 1]
Witter et al., 2012[67]	BD5. Pay-for-performance schemes	JAA15. Vaccination coverage (unspecified)	<ul style="list-style-type: none"> • Vaccination coverage (unspecified): (k = 2 studies): inconclusive, very low certainty evidence [p. 3, pp. 60-1, Table 8]
Oyo-Ita et al., 2016[63]	BF1. Health system strategic planning	JAA05. DPT3; JAA11. Measles; JAA03. DPT1; JAA02. BCG	<ul style="list-style-type: none"> • DPT3: favourable effect, low certainty (k = 1 study) [p.17] • Measles: inconclusive effect, low certainty (k = 2 studies) [p.18] • DPT 1: inconclusive effect, low certainty (k = 1 study) [p.18] • BCG: inconclusive effect, low certainty (k = 1 study) [p.18]
Odendaal et al., 2018[62]	BF4. Health system financing	JAA15. Vaccination coverage (unspecified); ICA1. Stockouts	<ul style="list-style-type: none"> • Vaccination coverage (unspecified): little or no impact (k = 1 study), moderate certainty evidence [p.4 & p.21] • Stockouts: inconclusive (k = 1 study) [refer p.22]
Lagarde & Palmer, 2009[57]	BF4. Health system financing	JAA01. Full routine immunization for children	<ul style="list-style-type: none"> • Full immunisation coverage: no significant impact (k = 1 study) [Table 2, p.18]

As in the case of caregiver-oriented intervention categories (A), we find a number of combinations where 3rd tier intervention categories are combined with each other. Table 13 below summarises these combinations in the context of health-systems oriented interventions (B). Table 13 is based on only 4 reviews. Gera et al. (2016)[53] and Willey et al. (2013)[66] focus on formal health worker training and education (BA1) and health system strategic planning (BF1) with Gera et al. (2016)[53] finding no evidence suggesting that DPT3 or measles coverage has improved while Willey et al. (2013)[66] find favourable evidence on vaccination (unspecified) and measles coverage. Both reviews rely on small study numbers (1-3 studies) not making any suggestions as to which one of the interventions components may have driven the results. Glenton et al. (2011)[54] looked at promoting outreach to vaccine-hesitant groups (BB4) and national/sub-national immunisation days (BC1) suggesting inconclusive effects on full routine immunisation for children and Jain et al. (2022)[41, 42] focus on outreach to vulnerable populations (hard-to-reach, SES, caste, etc.) (BB5) and collaborating with whole community (DA1) also presenting inconclusive effects. Jain et al. (2022)[41, 42] also looked at pay-for-

performance schemes (BD5) in combination with health system strategic planning (BF1) and collaborating with whole community (DA1), again, finding inconclusive effects drawing on small study numbers. It is not clear what we conclude from this rather heterogenous evidence base in relation to different combinations of health-systems oriented interventions (B) as the study numbers are too small, the outcomes too varied and the quality of the evidence base is questionable.

Table A10.2: B. Health-systems oriented interventions - more than one intervention (all high confidence systematic reviews)

Systematic review	Intervention, 3 rd tier level	Outcome	Finding
Gera et al., 2016[53]	BA1. Formal health worker training and education; BF1. Health system strategic planning	JAA11. Measles; JAA05. DPT3	<ul style="list-style-type: none"> • DPT 3 coverage: little or no evidence of improved coverage (k = 2 studies) [p.18, Analysis 1.6] • Measles coverage: little or no evidence of improved coverage, moderate certainty evidence (k = 3 studies) [p.18, Analysis 1.5]
Willey et al., 2013[66]	BA1. Formal health worker training and education; BF1. Health system strategic planning	JAA15. Vaccination coverage (unspecified); JAA11. Measles;	<ul style="list-style-type: none"> • Vaccination coverage (unspecified): improved (k = 1 study) [p. 58, Table 3.5] • Measles coverage: improved (k = 1 study) [p. 65, p.69, Table 3.6]
Glenton et al., 2011	BB4. Promoting outreach to vaccine-hesitant groups; BC1. National/sub-national immunisation days	JAA01. Full routine immunization for children	<ul style="list-style-type: none"> • Full routine immunization for children: inconclusive effect (k = 2 studies) [p.1050]
Jain et al., 2022[41, 42]	BB5. Outreach to vulnerable populations (hard-to-reach, SES, caste, etc.); DA1. Collaborating with whole community	HAD5. Vaccination health card availability/retention	<ul style="list-style-type: none"> • Vaccination health card availability/retention: inconclusive (k = 4 studies) [see Supplementary Figure CECA, Appendix 8].
Jain et al., 2022[41, 42]	BD5. Pay-for-performance schemes; BF1. Health system strategic planning	IAB3. Formal HW motivation, capacity & performance	<ul style="list-style-type: none"> • Formal HW motivation, capacity & performance: inconclusive effect (k = 2 studies) [refer fig. 94, Appendix 8]
Jain et al., 2022[41, 42]	BD5. Pay-for-performance schemes; DA1. Collaborating with whole community	HAD4. Experience and satisfaction with health services	<ul style="list-style-type: none"> • Experience and satisfaction with health services: inconclusive (k = 2 studies) [see Supplementary Figure 17].

Notes: Oyo-Ita et al. (2016)[63] captures intervention combinations spanning across A. caregiver-oriented and B. health-systems oriented interventions (e.g., BB5. pay-for-performance schemes and AB1. material/ monetary incentives for caregivers; BF1. Health system strategic planning and AB1. material/ monetary incentives for caregivers), thus this study has been taken out from this table as captured in Table 11 already. Likewise, Glenton et al. (2011)[54] examining BB7. home visits And AA2. Short-term sensitization and education campaigns. This table contains studies examining more than one intervention: Two health-system oriented interventions or one health system-oriented intervention with any other intervention.

Appendix 13: Community-level interventions

We are combining intervention categories C., D, and F. as we have very limited evidence on these categories. As none of this evidence contains sufficient quantitative information, we adopt a narrative approach. For other community-member oriented interventions (C), we have identified no high or medium confidence studies that provide information on this intervention category. As for community-level interventions (D), Table A7 summarises the only 2 high and medium reviews we have found for this intervention category. For multicomponent interventions (F), we have identified 2 reviews.[41, 42, 55] However, only Jain et al. (2022)[41, 42] contains information on community-level interventions (as well as on health-systems oriented interventions (B), thus Jain et al (2022)[41, 42] has been included into the discussion here.

Table A11: D. Community-level interventions

Systematic review	Confidence	Intervention, 3 rd tier level	Outcome	Finding
Molina et al., 2016[61]	High	DA1. Collaborating with whole community	JAA15. Vaccination coverage (unspecified)	Vaccination coverage (unspecified): significantly improved (k = 2 studies) and inconclusive (k = 1 study) [P.60, table 10, Figure 7]
Desai et al., 2020[71]	Medium	DA2. Collaborating with selected community groups and networks	JAA15. Vaccination coverage (unspecified)	Vaccination coverage (unspecified): Inconclusive (k = 2 studies) [p.4]

Let us take a closer look at community-level interventions (D), we only have 2 reviews to consider, the one by Molina et al. (2016)[61] investigates collaborating with whole community (DA1) presenting mixed results, 2 of their included studies seem to suggest significant improvements for vaccination coverage (unspecified) while 1 of their studies suggests inconclusive effects for the same outcome. Jain et al. (2022)[41, 42] have also examined collaborating with whole community (DA1) in relation to vaccination health card availability and satisfaction with health services finding inconclusive effects. The other study listed in Table A8 is the one by Desai et al. (2020)[71] which is of medium confidence and focusing on collaborating with selected community groups and networks (DA2). The outcome of interest is vaccination coverage (unspecified), and the results are inconclusive drawing on 2 studies. These results do not fill us with much confidence with regard to understanding what type of community-level interventions are effective in terms of improving immunisation outcomes. Looking at Jain et al. (2022)[41, 42] more closely, we can detect some favourable effects. They use a nuanced framework to classify single and multicomponent interventions based on the process of engaging communities, which does not fit neatly into the community-oriented categorisation of interventions used in this review. Nevertheless, drawing on 28 studies, which are a combination of demand and supply side interventions that include aspects of caregiver-oriented interventions (A) focusing on education, incentives, written messages and general community engagement, have favourable effects on full immunisation coverage. The same combination of interventions has favourable effects also on DPT3 vaccination coverage (drawing on 22 studies), on measles coverage (20 studies), on BCG (12 studies), on partial immunisation, OPV3, and immunisation knowledge (all 9 studies) as well as on vaccination timeliness of DPT3 (7 studies) and on vaccination timeliness for full immunisation, DPT2, OPV1 and 2 (all 5 studies). However, these findings confirm our previous observations, namely that the evidence base is highly heterogenous in terms of intervention categories and outcomes, it is also relying on a very limited pool of studies with varying quality. Except for caregiver-oriented interventions (A), we have an insufficient knowledge of the effectiveness of health-systems oriented interventions (B) and single community-level interventions (C and D). We found no evidence on non-health related policies and institutions (E) and have yet to understand which interventions best complement one another to enhance immunisation outcomes.

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