National Institute for Health and Care Excellence

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Draft for consultation

Vaccine uptake in the general population

[G] Evidence review for interventions to increase the uptake of routine vaccines by improving infrastructure

NICE guideline <number>

Evidence reviews underpinning recommendations 1.1.5-1.1.6 and 1.1.14-1.1.15 and research recommendations in the NICE guideline

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These evidence reviews were developed by the Guideline Updates Team

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ISBN:

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1.1 Review question

What are the most effective interventions for increasing the uptake of routine vaccines by improving infrastructure?

1.1.1 Introduction

The UK has a routine vaccination schedule covering key vaccinations for different stages in life including childhood, adolescence, pregnancy, and old age (65 years and older). Current practice is for healthcare professionals to advise people to accept these vaccinations at the relevant times unless contraindicated. However, the incorrect linking of the MMR vaccine to autism resulted in a reduction in MMR vaccination which is now being reflected in an increase in the number of cases of measles. There were 991 confirmed cases of measles in England in 2018 compared with 284 in 2017 and the World Health Organization no longer considers measles 'eliminated' in the UK. Although vaccination levels in general in the UK are relatively high, levels of uptake vary between vaccines and the age groups they are targeted at. For example, 5-in-1 coverage of children measured at 5 years was 95.2% in 2019/2020, while 83.9% of Year 9 females completed the 2-dose HPV vaccination course in 2018/19. By contrast, from April 2018 to March 2019, shingles vaccine uptake for the 70-year-old routine cohort was only 31.9%, pneumococcal vaccine uptake for all people aged 65 years and over was 69.2%, and pertussis vaccine coverage in pregnant women was 68.8%. However, vaccination rates need to be actively maintained and ideally increased in the face of increasing vaccine scepticism and misinformation. The COVID-19 pandemic has also reduced routine vaccination rates and is likely to continue to disrupt routine vaccinations in the foreseeable future, with Public Health England reporting that childhood hexavalent vaccinations were 3.1 percentage points lower at the beginning of 2021 than they were at the beginning of 2020 and the proportion of children receiving the 1st MMR vaccine was 2.2 percentage points lower. In addition, certain population groups (such as some Travellers and migrants) have lower levels of vaccination than the general public and additional or different actions may be required to increase their vaccination rates.

Reasons for low uptake may include poor access to healthcare services; inaccurate claims about safety and effectiveness, which can lead to increased concerns and a reduction in the perceived necessity of vaccines; and insufficient capacity within the healthcare system for providing vaccinations. In addition, problems with the recording of vaccination status and poor identification of people who are eligible to be vaccinated may have contributed to this problem. This review aims to identify effective interventions to increase the uptake of routine vaccines by improving access. It follows the protocol and overarching review question detailed in Appendix A, which has been divided across several review documents by intervention type and is summarised Table 1.

1.1.2 Summary of the protocol for interventions aimed at improving infrastructure

Table 1 PICO table for interventions to increase routine vaccine uptake by improving infrastructure

Population	• All people who are eligible for vaccines on the routine UK immunisation schedule and their families and carers (if appropriate).

	• Staff including, but not limited to, those providing advice about or administering vaccines and those people with relevant administrative or managerial responsibilities.
Intervention	Interventions including, but not confined to: 1. Interventions to improve infrastructure (targeting processes, staffing and settings): • Booking systems • dedicated vaccination lines or online systems • Organisation of local provider-based systems: • Local area approaches • Systems and processes in place to work with the community • Practice level approaches • Assigned lead for a specific vaccination programme • Having staff who are competent to deliver vaccinations available in multiple settings • Having staff with responsibilities for training practitioners, answering complex questions, co-ordinating immunisations etc. • Systems involved in the recording and identification of eligibility and status (covered in RQ1- see this review protocol for a list of potential interventions) • Incentives based interventions: • Incentive (and disincentives for not vaccinating) schemes (for individuals) • voucher schemes (not to cover cost of vaccination or healthcare) • payment to cover travel costs • fines/ penalties for not vaccinating • entry to childcare settings/ schools blocked in the absence of proof of vaccination status • Mandatory vaccination • Incentive schemes (for providers) • targets • quality and outcomes framework • voucher schemes • Audit and feedback on uptake rates for providers • Weekly statistics • Content and delivery of feedback • Practical relevance (e.g. how many more people need to be vaccinated to achieve a target number) • Comparison data (e.g. between GP practices)
Comparators	• Usual approaches to increase vaccine uptake • Other interventions to increase vaccine uptake • Other interventions targeting same issue/ theme (for example one type of infrastructure intervention versus another, such as provider incentives versus audit and feedback) • Other interventions targeting different issues/ theme (for example education versus infrastructure)
Outcomes	• Changes in: • Vaccine uptake (overall for a specific vaccine or vaccines and for each dose where a vaccine is administered in multiple doses) • the proportion of people offered vaccinations • the numbers of people who develop the disease the vaccination was aimed at preventing • Cost/resource use associated with the intervention

1.1.3 Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in appendix A and the methods document. Declarations of interest were recorded according to NICE's conflicts of interest policy.

Quantitative evidence

This review is one of a series of reviews looking at interventions to increase uptake (see appendix A for the full protocol covering all of the intervention types). Some of the following text has been duplicated as it applies to all reviews, but other sections are specific to this review.

The following additional methods apply across intervention types:

1. This review refers to the UK routine vaccination schedule. The November 2019 schedule was used when these reviews were carried out and is available with the current version of the complete routine immunisation schedule. Influenza vaccination is not covered by this guideline because there is a separate NICE guideline on Flu vaccination: increasing uptake.
2. In this guideline, the term pregnant woman is used to include women who are pregnant as well as transgender or non-binary people who are pregnant. This terminology is used to maintain consistency with NHS websites.
3. A date limit of 1990 was used for all reviews because the vaccination schedule for babies changed in 1990. This will include papers published after the MMR scandal of 1998 when attitudes to vaccinations changed in the UK and the numbers of vaccine related studies increased greatly.
4. A search for systematic reviews (SRs) of interventions to increase routine vaccine uptake was carried out. This was used to identify any SRs that could be used to answer the review questions directly with/ without additional searching being required to update them. However, all but 4 of them were subsequently excluded because they did not map sufficiently well to our review protocols. The most recent SRs were used to help design the search strategies to identify relevant primary intervention studies, and as a source of references.
5. Targeted searches were carried out to fill the gaps focusing on identifying primary studies that corresponded to each type of intervention as listed in the PICO in Table 1. These searches used RCT study type limits where it had been determined by reference to the SRs that there were many RCTs for this intervention type (for example, reminders). Where there was less certainty no study type limits were used during the search.
6. These primary searches were pooled with the SR search results in a single database for sifting and included studies were divided by intervention type for analysis. The search results were pooled to enable deduplication of results because the search results for particular types of interventions also frequently returned references for other types of interventions.
7. At the start of each intervention review, the included studies were examined in more detail and a decision was made whether to limit the included studies to RCTs and cluster RCTs, or whether additional study types were needed. Where insufficient RCT or cluster RCT evidence was identified then non-randomised controlled studies, cohort studies or interrupted time series studies were included. Where there was still a very limited evidence base then controlled before-and-after studies and finally uncontrolled before-and-after studies were included. Decisions were made in consultation with the committee. Where the study type limits were used then the remaining studies for that intervention type that did not met the additional inclusion criteria were excluded.
8. Where studies have more than 2 arms they may be included in more than one review if the intervention types differ, but a single comparison is only presented in a single review.
9. Where studies have multicomponent interventions they are included in the main intervention reviews if they have 2 components (for example, education and reminders),

but where they have more than 2 vaccine specific interventions they have been included in the multicomponent review. However, if the intervention has two types of the same group of interventions (for example, provider and patient education or provider audit with feedback) these have not been counted separately. Table 2 in the multicomponent review (evidence review H) summarises where these studies have been analysed.

10. The committee agreed not to include grey literature in the search for this topic because they thought it would be time consuming to identify and that it would be hard to find relevant literature. They agreed that if insufficient evidence is identified from the included study types, they would consider a focused call for evidence instead or look at indirect evidence.
11. Where no or limited direct evidence was required, indirect evidence was obtained by looking at the NICE guideline on Flu vaccination: increasing uptake. This evidence was limited that covering routine flu vaccination, not vaccination of high-risk groups (that are not covered by the routine schedule) or vaccinations that are purchased privately. Where the flu guideline did not address the review question directly, we referred to any relevant recommendations the flu committee made instead.
12. The countries of interest were limited to those in the Organisation for Economic Co-operation and Development (OECD) because less economically developed countries are likely to have different reasons for low levels of vaccine uptake associated with less well-developed healthcare systems. As a result, interventions to improve uptake in these countries are less likely to be relevant for the UK.
13. For studies looking at specific vaccines to be considered for inclusion, the vaccinations included in the study must be in the routine vaccination schedule of the UK and the country where the study was conducted. Routine vaccination schedules of countries other than the UK were checked using the WHO vaccine-preventable diseases: monitoring system unless a more up -to-date, approved, national/regional immunisation schedule was identified online.
14. If a study presented data on multiple vaccines, that are not all on the UK routine schedule and we cannot extract data separately for the vaccines on the UK schedule then the study was excluded.
15. If study reports uptake of childhood vaccinations (e.g. up to date by 2 years old) and doesn't specify the vaccination, but we know that the schedule in that country (US normally) has some differences to UK schedule, we have included the study and not downgraded for applicability if the majority of the vaccinations on the schedule are the same as UK. This approach was agreed with the committee.
16. Studies using vaccine formulations that differ from those used in the UK have not been excluded if the vaccines included in the formulation target the same diseases as the UK versions and are used at the same time as on the UK routine schedule. The committee agreed that it was the presence of a vaccination against a disease on the routine schedule rather than the formulation of the vaccination that was important.
17. Interventions may be generic or targeted (tailored to the needs of the individual/ group.) They may target individuals or groups of individuals (ie. a community). Interventions targeting individuals may be provided at the individually or as a group.
18. Where the comparator in an analysis is listed as the usual approach this defined as whatever is the standard approach to vaccination in at the time that an eligible study was carried out. If further details are available, then they are provided in the evidence tables.
19. Studies looking at catch-up campaigns were included if the campaigns were as follows:
    - opportunistic in those that missed a vaccination, and
    - catch-up campaigns in under-vaccinated groups.

    Catch-up campaigns following a disease outbreak were not included.
20. Outcomes:
    - Vaccine uptake is defined as the proportion of people being vaccinated with individual vaccines or overall (for all eligible vaccines). It is a dichotomous outcome.
    - Occurrence of disease is defined however the study reports it at the end of the intervention.

- Any studies that only reported change in offers and not uptake were excluded from the review because the committee are only interested in how changes in the numbers of offers relate to changes in uptake. Increased uptake may be caused by increased offers or an increase in offers may not translate into increased uptake.

21. Network meta-analyses were not prioritised for the intervention reviews due to the expected variability between interventions, populations and types of vaccine. Instead, additional analysis time was used to try to triangulate the findings from the quantitative and qualitative reviews using a mixed methods approach. (See below in the review specific methods for more details about the approach used in this review.)
22. Since non-randomised trials and cohort studies are assessed for risk of bias using ROBINS-I they could be combined in a meta-analysis with RCTs in GRADE (starting at high quality). However, although the inclusion of these NRS could be used to provide more precise estimates in summary effects they were not combined in the intervention reviews because the NRS are expected to be much larger and may dominate such estimates. Interrupted time series and before and after studies were also analysed separately by study type.
23. Different risk of bias checklists may use different terminology to represent the overall risk of bias judgements and for domain summaries. Where they differ from those used in the methods chapter for this review the following applies:
    - Some concerns = moderate risk of bias
    - Serious = high risk of bias
24. No clinically meaningful differences were identified by the committee, and they were unwilling to define MIDs here because they thought the clinically meaningful change in uptake may differ between vaccinations. Therefore, the line of no effect was used to downgrade for imprecision.
25. The interpretations in the GRADE summary tables of evidence are as follows:
    - We state that the evidence showed that there is an effect (e.g., increase or decrease) if the 95% confidence interval (CI) does not cross the line of no effect.
    - The evidence could not differentiate between comparators if the 95% CI crosses the line of no effect.

Qualitative evidence

The qualitative evidence for this review was taken from evidence review B. Please see the methods detailed there for more information about how the findings were derived.

Infrastructure review specific methods

1. The committee agreed that in the context of vaccinations infrastructure referred to the organisation of the system which includes the settings where vaccinations are administered, staffing (at local and national levels) and the processes in place (including training of staff) around vaccinations.
2. Incentive based interventions excluded those that involve paying for the cost of the vaccination or healthcare costs because these are free in the UK.
3. Studies of intervention versus control were included if the controls were the following:
    - No intervention
    - Usual practice. Studies did not need to specify what was usual practice was.
    - Part of the interventions cancelled each other out (such as 2 arms including education, or an active control such as information about another vaccination).
4. Where possible, cRCTs were adjusted for clustering using the following method: If the intra-cluster correlation coefficient (ICC) and number of clusters in each arm were provided, we used this information to adjust the vaccine uptake data for clustering. If one or more studies had an ICC but others did not, we used the most common ICC in this evidence review for the studies that did not have one. If no ICC was provided in a study or in another similar study we used an ICC value of 0.05 because this was the most

common ICC in the education and reminders evidence review. If a footnote says under a forest plot that the data was adjusted for clustering, it was adjusted by us unless stated otherwise.

5. Interrupted time series and before and after studies were not included in the review because the committee agreed that we had a sufficient number of RCTs, cRCTs, non-randomised trials and cohort studies.
6. A mixed methods summary was made which combined the main infrastructure-related findings from the qualitative barriers and facilitators review (evidence review B) with the relevant quantitative results from this review. Findings relating to infrastructure were identified from review B and the ones that were considered to be most important were summarised in section 1.1.6. These findings spanned the age groups and life stages and were further summarised to produce a diagram with key barriers and facilitators to vaccine uptake that related to infrastructure. Where possible links were made between barriers and corresponding facilitators that had been raised in the findings themselves or that were logically linked. At this point the quantitative evidence was mapped onto the qualitative evidence. So, for example, if a barrier concerned clinician targets and incentives and there was quantitative evidence from a study using financial incentives for healthcare providers then the results of this study were summarised and placed in a box linked to the relevant barrier or facilitator. If a study could not be linked to a barrier or facilitator then it was shown in separate box at the side of the diagram.
7. For the mixed methods diagram, where quantitative studies had reported results for different doses HPV vaccines, the results were presented for the first dose of the vaccine. Where quantitative studies have reported on different vaccines (e.g., childhood vaccines), the results for the first vaccine on the corresponding forest plot have been reported.

1.1.4 Effectiveness evidence

A series of searches were carried out to identify evidence to answer the overall review question about effective interventions to increase uptake. Firstly, a search for systematic reviews (SRs) of interventions to increase routine vaccine uptake was carried out. This search returned 2190 references.

Additional searches were carried out to identify primary studies for all the intervention types listed in the full review protocol (see Appendix A). These searches were pooled with the SR search results in a single eppi 5 database for sifting to enable deduplication of results because the search results for particular intervention groups also frequently returned references for other intervention groups. As a result, it is harder to assign individual references to particular search results than would normally be the case. The numbers provided below refer to the pooled searches unless stated otherwise.

In total 19254 studies were screened at title and abstract level against the review protocol and 738 were included for screening at full text. Of these 215 matched the inclusion criteria and were divided into SRs or separate intervention types (education, infrastructure, access, reminders, acceptability) or multicomponent to match the evidence reviews.

Of the SRs that met the inclusion criteria all but 4 were subsequently excluded (see methods for more details of this process; the numbers above have taken this process into account and only include the 4 SRs). The 4 SRs were sufficiently well matched to a particular review question to be included as directly applicable evidence and were judged to be high-quality (following a ROBIS quality assessment). None were relevant for this review.

Of the included primary studies, 16 met the criteria for inclusion in the infrastructure review.

The systematic review search and the primary searches were rerun at the end of the guideline development process to identify any newly published references that were relevant for this and other reviews. Of the 1752 new references, 67 were ordered at full text to screen for inclusion in the intervention reviews. Of these, no SRs matched the inclusion criteria

closely enough to be included in any of the reviews. 4 additional primary studies were included at this stage. No additional primary studies were identified that were relevant for this review. Therefore, this review consisted of 16 included studies.

For study selection, please see Appendix C.

1.4.1 Included studies

The 16 studies targeted individuals, parents, carers or health care providers (Table 2) and were a mix of RCTs, cRCTs, and cohort studies. They looked at infrastructure interventions versus controls (usual practice) or infrastructure interventions (alone or in combination) compared to other interventions to increase vaccine uptake.

The studies were as follows:

- Four studies (2 RCT, 1 cohort, and 1 non-randomised controlled trial) looked at infrastructure interventions aimed at individuals, parent and carers compared to control. These studies focused on financial incentives or penalties, and education and school entry mandates.
- Two studies (1 cluster RCT and 1 cohort) looked at infrastructure interventions aimed at individuals, parents and carers compared to another intervention. These studies compared school entry and education mandates or financial incentives versus reminders.
- One RCT looked at infrastructure interventions plus another intervention (financial incentives with reminders) aimed at individuals, parents and carers compared to control.
- Three studies (1 cluster RCT and 2 cohort) looked at infrastructure interventions aimed at healthcare provider compared to control. These studies looked at financial incentives or feedback, or the use of algorithms to help with decision making.
- Four cluster RCTs looked at infrastructure interventions plus another intervention aimed at healthcare providers compared to control. The studies looked at education, with assessment and feedback; and bonuses or enhanced fee with feedback.
- Two cluster RCTs looked at infrastructure interventions (bonus for performance versus enhanced fee for service) aimed at healthcare providers compared to a different intervention.
- Two cohort studies looked at infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to control. The studies looked at continuity of care and maternity services that offered vaccinations.
- Three studies (2 cohort studies, 1 non-randomised controlled trial) looked at infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to a different intervention. These included comparing provider and clinic continuity; using a vaccine manager versus enhanced usual care; and a public health nurse delivered programme in public health clinics versus a family physician delivered programme in family physician offices.

Note: The numbers of studies listed above is greater than the included study numbers because there were five 3 arm studies and one 4 arm study (although 1 arm of a 3 arm study, Birkhead 1995, is not included in this review because it is more relevant to the access intervention review as explained in the summary of studies table in the next section.)

1.1.4.2 Excluded studies

The list of excluded studies with reasons for their exclusion are available in Appendix J.

1.1.5 Summary of studies included in the effectiveness evidence.

Table 2 Summary of the characteristics of the primary studies for interventions aimed at individuals, parents and carers

Author (year)	Country	Sample size	Study design	Setting	Target population for vaccination	Interventions	Comparators	Vaccine(s)	Relevant outcomes
Birkhead 1995	USA	836	Cluster RCT	Hospital paediatric clinics	Children aged 12 to 59 months	**Intervention 1:** Food vouchers provided monthly instead of every 2 months until the child was vaccinated. [Education provided too.] **Intervention 2:** Escorted to vaccination section of a paediatric clinic with vouchers provided afterwards. [Education provided in all arms.][3]	Referral to vaccination clinic elsewhere (reminder). [Education provided too.]	Measles	Vaccine uptake
Caskey 2017	USA	188	Quasi-randomised controlled trial	Paediatric clinics	Adolescents 11 to 17 years of age	Escalating delayed cash incentives for the 1st, 2nd and 3rd HPV vaccine doses.	Usual care	HPV (Human papillomavirus)	Vaccine uptake
Kerpelman 2000	USA	850	RCT	Community	Children aged ≤2 years of age[2]	Threat of removal of welfare benefit.	Usual care. Encouraging words were used.	DTP (Diphtheria, tetanus, pertussis), polio, MMR (Measles, mumps, and rubella), Hib (Haemophilus influenzae	Vaccine uptake

Author (year)	Country	Sample size	Study design	Setting	Target population for vaccination	Interventions	Comparators	Vaccine(s)	Relevant outcomes
								type b), HepB (Hepatitis B)	
Mantzari 2015	UK	1000	RCT	Community clinics	Adolescents aged 16 to 18 years old	Financial incentives and reminder text message.	Control (a reminder letter and information leaflet that was sent to both arms)	HPV	Vaccine uptake
Minkovitz 1999	USA	853	RCT	Community	Children aged 3 to 24 months	Threat of removal of welfare benefit	Control	DTP, polio, MMR	Vaccine uptake
Perkins 2016	USA	47845	Cohort study	Schools	Girls aged 13 to 17 years	**Intervention 1:** Education mandate. **Intervention 2:** School entry mandate.	Control (no mandate)	HPV	Vaccine uptake

1. A picture of the algorithm can be seen here.
2. Kerpelman 2000 recruited up to 6 years of age but the vaccine series completion data was measured at 2 years of age and this data was most relevant to this review. Data up to 6 years of age was separate vaccine uptake data for DTP, polio, MMR, Hib, and HepB, which would be less straight-forward to evaluate.
3. Comparisons with Intervention 2 of Birkhead 1995 can be found in the access evidence review. It is not used as a comparison in this review.

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2 **Table 3 Summary of the characteristics of the primary studies for interventions aimed at healthcare professionals**

Author (year)	Country	Sample size	Study design	Setting	Target population for vaccination	Access interventions	Comparators	Vaccine(s)	Relevant outcomes
Christy 1997	USA	2101	Cohort study	Hospital-based paediatric primary care centres	Children aged 2 to 60 months	Algorithm for nurses that served as a guideline for vaccination management[1]	Usual care	DTP, polio, MMR, Hib	Vaccine uptake

Author (year)	Country	Sample size	Study design	Setting	Target population for vaccination	Access interventions	Comparators	Vaccine(s)	Relevant outcomes
Fairbrother 2001	USA	2815	Cluster RCT	Family practices and paediatric clinics	Children 3 to 35 months of age	**Intervention 1:** Bonus for vaccination performance and feedback. **Intervention 2:** Enhanced fee for service and feedback.	Feedback on a clinical issues unrelated to vaccines.	DTP, Hib, polio, MMR	Vaccine uptake
Fairbrother 1999	USA	3019	Cluster RCT	Family practices and paediatric clinics	Children 3 to 35 months of age	**Intervention 1:** Bonus for vaccination performance and feedback. **Intervention 2:** Enhanced fee for service and feedback. **Intervention 3:** Feedback only	Feedback on a clinical issues unrelated to vaccines.	DTP, Hib, polio, MMR	Vaccine uptake
Gavagan 2010	USA	544	Cohort study	Community health centres	Children aged 0 to 18 years	Financial incentives for physicians	Control. No financial incentives and feedback on performance was the same for both arms.	General childhood vaccinations [1]	Vaccine uptake
Gilkey 2019	USA	22983	Cluster RCT	Health clinics	Adolescents aged 12 to 14 years	Face-to-face physician training coupled with assessment and feedback	Control (waiting list control arm with no additional physician training)	HPV	Vaccine uptake
Gilkey 2014	USA	71628	Cluster RCT	Paediatric and family practice clinics	Adolescents aged 11 to 18 years	**Intervention 1:** Face-to-face physician training coupled with assessment and feedback. **Intervention 2**: webinar physician training coupled with	Usual care	HPV, Tdap (Tetanus, diphtheria, pertussis), MenACWY Meningococcal A, C, W and Y), pertussis,	Vaccine uptake

Author (year)	Country	Sample size	Study design	Setting	Target population for vaccination	Access interventions	Comparators	Vaccine(s)	Relevant outcomes
						assessment and feedback.		MMR, HepB, varicella[2]	

1. Gavagan 2010 did not specify what vaccines were included – they were general vaccines for children.
2. The data for HPV and MenACWY vaccines were included in the analysis. However, the data for pertussis, MMR, Tdap, HepB and varicella vaccines were excluded because they are not on the routine vaccination schedule for 11-18 years olds in the UK.

Table 4 Summary of the characteristics of the primary studies for interventions aimed at individuals, parents and carers, and healthcare professionals

Author (year)	Country	Sample size	Study design	Setting	Target population for vaccination	Access interventions	Comparators	Vaccine(s)	Relevant outcomes
Gill 2002	USA	187	Cohort study	Primary care clinics	Infants ≤1 year old	**Intervention 1:** Same provider and clinic for prenatal and well-childcare. **Intervention 2:** Same clinic but different provider for prenatal and well-childcare.	Different clinic and a different provider for prenatal and well-childcare.	DTP, polio, Hib, HepB	Vaccine uptake
Landis 1995	USA	1252	Non-randomised controlled study	Hospital wards	Adults (age was not defined)[1]	Vaccine-manager group. Hospital nurse practitioner who could assess the need for and dispense vaccines independently.	Enhanced usual care group. Nurses required prescription from a physician.	Td (Tetanus, diphtheria), pneumococcal, rubella, measles[2]	Vaccine uptake
Llamas 2020	UK	587502	Cohort study	Maternity services and primary care	Pregnant women	Clinical commissioning groups implementing maternity services that offered pertussis vaccinations	Usual care (the pertussis vaccine was mostly delivered through primary care)	Pertussis vaccine	Vaccine uptake

Author (year)	Country	Sample size	Study design	Setting	Target population for vaccination	Access interventions	Comparators	Vaccine(s)	Relevant outcomes
Zelman 2014	Canada	Approximately 5641[a]	Cohort study	Public health clinics and family physicians' offices	Infants ≤1 year old	A public health nurse administered programme in public health clinics	A family physician administered programme in family physician offices	Rotavirus vaccine	Vaccine uptake

1. The mean age for the vaccine-manager group was 57.22 years and the mean age for the enhanced usual care group was 52.77years. In the study overall the mean age was over 50 years.
2. For this evidence review, only data for pneumococcal vaccine was relevant to the UK population aged 65+.

a) This is an approximation based on yearly birth rates in the areas where the interventions took place during the time of the study.

For the full evidence tables, please see Appendix D.

1.1.6 Summary of the evidence

Summary of the quantitative evidence

Infrastructure interventions aimed at individuals, parents and carers compared to control

See 1.1.3 Methods and process for an explanation of the interpretation column.

Table 5 Summary of effectiveness findings for financial incentives or penalties

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
Threat of removal of welfare benefit versus control (RR >1 favours financial threat)							
0-5 years old							
2 (Kerpelman 2000, Minkovitz 1999)	RCT	1703	RR 1.09 (0.91, 1.30)	64 per 100	70 per 100 (58, 83)	The studies could not differentiate change in vaccine uptake between threat of removal of welfare benefit or control.	Very low
Threat of removal of welfare benefit versus control (RR >1 favours financial threat)							
0-5 years of age, DTP vaccine uptake							
1 (Minkovitz 1999)	RCT	853	RR 0.94 (0.84, 1.05)	59 per 100	56 per 100 (50, 62)	The study could not differentiate change in vaccine uptake between threat of removal of welfare benefit or control.	Low
0-5 years of age, Polio vaccine uptake							
1 (Minkovitz 1999)	RCT	853	RR 0.99 (0.90, 1.09)	67 per 100	66 per 100 (60, 73)	The study could not differentiate change in vaccine uptake between threat of removal of welfare benefit or control.	Low
0-5 years of age, MMR vaccine uptake							
1 (Minkovitz 1999)	RCT	532	RR 0.99 (0.88, 1.11)	70 per 100	69 per 100 (62, 78)	The study could not differentiate change in vaccine uptake between threat of removal of welfare benefit or control.	Low

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
NON-RCT: Cash incentive versus control (RR >1 favours delayed cash)							
HPV 1st dose							
1 (Caskey 2017)	Quasi-randomised controlled trial	188	RR 1.62 (1.27, 2.05)	47 per 100	75 per 100 (59, 96)	Increased with escalating delayed cash incentive.	Low
HPV 2 or more doses							
1 (Caskey 2017)	Quasi-randomised controlled trial	188	RR 1.53 (1.08, 2.17)	33 per 100	51 per 100 (36, 72)	Increased with escalating delayed cash incentive.	Low
HPV 3 doses							
1 (Caskey 2017)	Quasi-randomised controlled trial	188	RR 2.89 (1.62, 5.16)	13 per 100	36 per 100 (20, 65)	Increased with escalating delayed cash incentive.	Low

Table 6 Summary of effectiveness findings for education or school entry vaccination mandates

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
NON-RCT: Education mandate or school entry mandate versus control (RR >1 favours mandate)							
Education mandate, HPV at least 1 dose							
1 (Perkins 2016)	Cohort study	46196	RR 0.98 (0.96, 1.00)	52 per 100	51 per 100 (50, 52)	Increased with control.	Low
Education mandate, HPV all 3 doses							

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
1 (Perkins 2016)	Cohort study	46196	RR 0.97 (0.94, 1.00)	35 per 100	34 per 100 (33, 35)	Increased with control.	Low
School entry mandate, HPV at least 1 dose							
1 (Perkins 2016)	Cohort study	35266	RR 1.02 (0.97, 1.07)	52 per 100	53 per 100 (50, 56)	The study could not differentiate change in vaccine uptake between school entry mandate or control.	Very low
School entry mandate, HPV all 3 doses							
1 (Perkins 2016)	Cohort study	35266	RR 1.00 (0.93, 1.07)	35 per 100	35 per 100 (33, 37)	The study could not differentiate change in vaccine uptake between school entry mandate or control.	Very low

Infrastructure interventions aimed at individuals, parents and carers compared to another intervention

Table 7 Summary of effectiveness findings for infrastructure interventions aimed at individuals, parents and carers compared to another intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Interpretation	Quality
Financial incentive (vouchers) versus reminder (RR >1 favours financial incentive)							
0-5 years							
1 (Birkhead 1995)	cRCT	69	RR 1.42 (1.01, 2.00)	55 per 100	78 per 100 (55, 100)	Increased with financial incentive.	Low
NON-RCT: School entry mandate versus education mandate (RR >1 favours school entry mandate)							
HPV at least 1 dose							
1 (Perkins 2016)	Cohort study	14228	RR 1.04 (0.99, 1.09)	51 per 100	53 per 100 (50, 56)	The study could not differentiate change in vaccine uptake between school entry mandate or education mandate.	Very low
HPV at least 3 doses							
1 (Perkins 2016)	Cohort study	14228	RR 1.03 (0.96, 1.10)	34 per 100	35 per 100 (33, 37)	The study could not differentiate change in vaccine uptake between school entry mandate or education mandate.	Very low

1 ***Infrastructure intervention plus another intervention aimed at individuals, parents and carers compared to control***

2 **Table 8 Summary of effectiveness findings for financial incentives with reminders**

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
Financial incentives and reminder text message for 2nd and 3rd HPV dose verses control (RR >1 favours intervention)							
Adolescents who were previously not invited for vaccination, 1st HPV dose							
1 (Mantzari 2015)	RCT	500	RR 1.45 (1.05, 1.99)	20 per 100	28 per 100 (21, 39)	Increased with additional reminder letter with financial incentives.	Moderate
Adolescents previously unresponsive to invitations, 1st HPV dose							
1 (Mantzari 2015)	RCT	500	RR 2.27 (1.48, 3.48)	10 per 100	24 per 100 (15, 36)	Increased with additional reminder letter with financial incentives.	Moderate
Adolescents who were previously not invited for vaccination, 2nd HPV dose							
1 (Mantzari 2015)	RCT	500	RR 1.52 (1.07, 2.18)	16 per 100	24 per 100 (17, 35)	Increased with additional reminder letter with financial incentives plus a reminder text message for the 2nd HPV dose.	Moderate
Adolescents previously unresponsive to invitations, 2nd HPV dose							
1 (Mantzari 2015)	RCT	500	RR 3.06 (1.79, 5.24)	6 per 100	20 per 100 (11, 34)	Increased with additional reminder letter with financial incentives plus a reminder text message for the 2nd HPV dose.	Moderate
Adolescents who were previously not invited for vaccination, 3rd HPV dose							
1 (Mantzari 2015)	RCT	500	RR 1.87 (1.24, 2.81)	12 per 100	22 per 100 (15, 34)	Increased with additional reminder letter with financial incentives plus a reminder text message for the 2nd and 3rd HPV dose.	Moderate
Adolescents previously unresponsive to invitations, 3rd HPV dose							
1 (Mantzari 2015)	RCT	500	RR 3.88 (1.82, 8.26)	3 per 100	12 per 100 (6, 26)	Increased with additional reminder letter with financial incentives plus a reminder text message for the 2nd and 3rd HPV dose.	Moderate

1 ***Infrastructure interventions aimed at healthcare provider compared to control***

2 **Table 9 Summary of effectiveness findings for financial incentives or feedback aimed at healthcare provider compared to control**

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
Financial incentives or feedback							
Interventions aimed at healthcare providers versus control (summary) (RR >1 favours intervention)							
0-5 years, bonus for performance							
1 (Fairbrother 1999)	cRCT	1510	RR 1.24 (1.12, 1.37)	44 per 100	55 per 100 (49, 60)	Increased with bonus for performance.	Moderate
0-5 years, enhanced fee for service							
1 (Fairbrother 1999)	cRCT	1510	RR 1.15 (1.03, 1.28)	44 per 100	51 per 100 (45, 56)	Increased with enhanced fee for service.	Low
0-5 years, feedback							
1 (Fairbrother 1999)	cRCT	1510	RR 1.08 (0.96, 1.22)	41 per 100	44 per 100 (39, 50)	The study could not differentiate change in vaccine uptake between feedback or control.	Very low
NON-RCT: Financial incentives for physicians versus control (RR >1 favours financial incentive for physicians)							
0-18 years old							
1 (Gavagan 2010)	Cohort study	544	RR 1.10 (1.05, 1.15)	90 per 100	99 per 100 (94, 100)	Increased with financial incentives for physicians.	Low

3 **Table 10 Summary of effectiveness findings for processes and systems changes compared to control**

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
NON-RCT: Algorithm to aid vaccination decision making for nurses versus control (RR >1 favours nurses' algorithm)							
0-5 years, DPT							

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
1 (Christy 1997)	Cohort study	635	RR 1.90 (1.40, 2.59)	15 per 100	29 per 100 (21, 40)	Increased with algorithm to aid vaccination decision making for nurses.	Low
0-5 years, polio							
1 (Christy 1997)	Cohort study	539	RR 1.81 (1.29, 2.54)	15 per 100	28 per 100 (20, 39)	Increased with algorithm to aid vaccination decision making for nurses.	Low
0-5 years, MMR							
1 (Christy 1997)	Cohort study	279	RR 1.65 (1.09, 2.51)	19 per 100	31 per 100 (21, 48)	Increased with algorithm to aid vaccination decision making for nurses.	Low
0-5 years, Hib							
1 (Christy 1997)	Cohort study	794	RR 1.27 (0.88, 1.83)	11 per 100	15 per 100 (10, 21)	The study could not differentiate change in vaccine uptake between algorithm to aid vaccination decision making for nurses or control	Very low

Infrastructure intervention plus other interventions aimed at healthcare providers compared to control

Table 11 Summary of effectiveness findings for intervention plus other interventions aimed at healthcare providers compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
Education, assessment and feedback versus control (RR >1 favours interventions)							
Face-to-face physician education with assessment and feedback							
2 (Gilkey 2014, Gilkey 2019)	cRCT	1630	RR 1.04 (0.78, 1.39)	38 per 100	40 per 100 (30, 53)	The studies could not differentiate change in vaccine uptake between face-to-face physician education with assessment and feedback or control.	Very low
Webinar education, assessment and feedback							

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
1 (Gilkey 2014)	cRCT	1158	RR 0.96 (0.81, 1.14)	32 per 100	31 per 100 (26, 37)	The study could not differentiate change in vaccine uptake between webinar education, assessment and feedback or control.	Moderate
Feedback and financial incentives versus control (RR >1 favours interventions)							
Feedback and bonus for good performance							
2 (Fairbrother 1999, Fairbrother 2001)	cRCT	3386	RR 1.32 (1.23, 1.41)	42 per 100	55 per 100 (51, 59)	Increased with feedback and bonus for good performance.	Low
Enhanced fee for service plus feedback							
2 (Fairbrother 1999, Fairbrother 2001)	cRCT	3386	RR 1.31 (1.22, 1.41)	42 per 100	55 per 100 (51, 59)	Increased with enhanced fee for service plus feedback.	Very low
Education with assessment and feedback versus control (RR >1 favours interventions)							
Face-to-face, 11-12 years, meningococcal							
1 (Gilkey 2014)	cRCT	1140	RR 1.15 (1.04, 1.27)	54 per 100	62 per 100 (56, 68)	Increased with face-to-face education plus assessment and feedback.	High
Face-to-face, 13-18 years, meningococcal							
1 (Gilkey 2014)	cRCT	1174	RR 1.01 (0.94, 1.09)	71 per 100	72 per 100 (67, 78)	The study could not differentiate change in vaccine uptake between face-to-face education plus assessment and feedback or control.	Moderate
Face-to-face, 11-12 years, HPV 1st dose							
1 (Gilkey 2014)	cRCT	1140	RR 0.90 (0.75, 1.07)	32 per 100	29 per 100 (24, 35)	The study could not differentiate change in vaccine uptake between face-to-face education plus assessment and feedback or control.	Moderate
Face-to-face, 13-18 years, HPV 1st dose							

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
1 (Gilkey 2014)	cRCT	1174	RR 1.03 (0.94, 1.13)	60 per 100	62 per 100 (56, 68)	The study could not differentiate change in vaccine uptake between face-to-face education plus assessment and feedback or control.	Moderate
Webinar, 11-12 years, meningococcal							
1 (Gilkey 2014)	cRCT	1158	RR 1.11 (1.00, 1.22)	54 per 100	60 per 100 (54, 66)	Increased with webinar education plus assessment and feedback.	High
Webinar, 13-18 years, meningococcal							
1 (Gilkey 2014)	cRCT	1192	RR 0.92 (0.85, 1.00)	71 per 100	66 per 100 (61, 71)	Increased with control.	High
Webinar, 11-12 years, HPV 1st dose							
1 (Gilkey 2014)	cRCT	1158	RR 0.96 (0.81, 1.14)	32 per 100	31 per 100 (26, 37)	The study could not differentiate change in vaccine uptake between webinar education plus assessment and feedback or control.	Moderate
Webinar, 13-18 years, HPV 1st dose							
1 (Gilkey 2014)	cRCT	1192	RR 0.97 (0.88, 1.06)	60 per 100	58 per 100 (53, 63)	The study could not differentiate change in vaccine uptake between webinar education plus assessment and feedback or control.	Moderate

Infrastructure interventions aimed at healthcare providers compared to a different intervention

Table 12 Summary of effectiveness findings for interventions aimed at healthcare providers compared to a different intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Interpretation	Quality
Bonus for performance versus enhanced fee for service							
0-5 years old							
2 (Fairbrother 1999,	cRCT	3386	RR 1.01 (0.90, 1.14)	55 per 100	55 per 100 (49, 62)	The studies could not differentiate change in vaccine uptake between bonus for performance or enhanced fee for service.	Very low

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Interpretation	Quality
Fairbrother 2001)							

Infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to control

Table 13 Summary of effectiveness findings for interventions aimed at individuals, parents and carers, and healthcare providers compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
NON-RCT: Interventions aimed at pregnant women, and healthcare providers versus control (summary) (RR >1 favours intervention)							
Provider continuity							
1 (Gill 2002)	Cohort study	110	RR 1.26 (1.10, 1.45)	77 per 100*	97 per 100 (85, 100)	Increased with provider continuity.	Low
Clinic continuity							
1 (Gill 2002)	Cohort study	143	RR 1.03 (0.86, 1.22)	77 per 100*	80 per 100 (66, 94)	The study could not differentiate change in vaccine uptake between clinic continuity or control.	Very low
Maternity services offering vaccinations							
Llamas 2020	Cohort study	587502	RR 0.92 (0.92, 0.92)	77 per 100*	70 per 100 (70, 70)	Increased with control.	Low
* The 77 per 100 is not an error and represents the absolute effects in the control arms for these trials by coincidence.							

Infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to a different intervention

Table 14 Summary of effectiveness findings for interventions aimed at individuals, parents and carers, and healthcare providers compared to a different intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Interpretation	Quality
NON-RCT: Provider continuity versus clinic continuity (RR >1 favours provider continuity)							

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Interpretation	Quality
0-5 years old							
1 (Gill 2002)	Cohort study	121	RR 1.23 (1.09, 1.39)	79 per 100	97 per 100 (86, 100)	Increased with provider continuity.	Low
NON-RCT: Public health nurse delivered programme in public health clinics versus family physician delivered programme in family physician offices (RR >1 favours public health nurse delivered programme in public health clinics)							
Rotavirus vaccine dose 1							
1 (Zelman 2014)	Cohort study	5641	RR 2.50 (2.40, 2.60)	38 per 100	95 per 100 (91, 99)	Increased with public health nurse delivered programme in public health clinics.	Very low
Rotavirus vaccine dose 2							
1 (Zelman 2014)	Cohort study	5641	RR 2.72 (2.60, 2.85)	34 per 100	92 per 100 (88, 96)	Increased with public health nurse delivered programme in public health clinics.	Very low
NON-RCT: Vaccine-manager group versus enhanced usual care group (RR >1 favours vaccine-manager group)							
65+ years old							
1 (Landis 1995)	Non-randomised	1252	RR 11.08 (5.91, 20.79)	1 per 100	15 per 100 (8, 28)	Increased with vaccine-manager group.	Low

Sensitivity analysis (removed studies at high risk of bias)

Table 15 Summary of effectiveness findings for intervention plus another intervention aimed at healthcare providers compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
Feedback plus a different intervention versus control (RR >1 favours intervention)							
Feedback and bonus for good performance							
1 (Fairbrother 1999)	cRCT	1510	RR 1.34 (1.20, 1.49)	41 per 100	54 per 100 (49, 61)	Increased with feedback and bonus for good performance.	Moderate
Enhanced fee for service plus feedback							

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Interpretation	Quality
1 (Fairbrother 1999)	cRCT	1510	RR 1.24 (1.11, 1.39)	41 per 100	50 per 100 (45, 57)	Increased with enhanced fee for service plus feedback.	Moderate

Table 16 Summary of effectiveness findings for interventions aimed at healthcare providers compared to a different intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Interpretation	Quality
Bonus for performance versus enhanced fee for service (RR >1 favours bonus for performance)							
0-5 years old							
1 (Fairbrother 1999)	cRCT	1510	RR 1.08 (0.98, 1.19)	50 per 100	55 per 100 (49, 60)	The study could not differentiate change in vaccine uptake between bonus for performance or enhanced fee for service.	Very low

See Appendix F for full GRADE tables

1 Summary of the qualitative evidence

2 Findings related to infrastructure taken from the barriers to and facilitators for vaccine uptake reviews in evidence review B. For more details and
3 additional findings please refer to this review.

4 **Table 17 Summary of the key qualitative findings relating to infrastructure**

Population to be vaccinated	Finding	Confidence
Pregnant women		
Vaccine safety, effectiveness, assessment of risk and discussions		
Pregnant women	Midwives and pregnant women agree that time pressures make it harder to discuss, gain consent for and carry out vaccinations. Some midwives say they lack dedicated time for obtaining consent.	Moderate
Training needs		
Pregnant women	Midwives say that they are not trained to administer vaccines.	Low
People aged 65 years and older		
Lack of information		
People aged 65 years and older	Emergency department nurses say that their usual training does not include vaccines for people aged 65 years and over. As a result, they do not know enough about vaccines for people aged 65 years and over in order to advise them and administer vaccines. They also say that they do not have information to hand about the relevant vaccines for people aged 65 year and over.	Very low
Sources of information and influence: discussing vaccination with healthcare providers		
People aged 65 years and older	GPs say that they are very busy. This is why vaccines for people aged 65 years and over are not often administered.	Low
Babies and children aged 0-5 years		
Discussions with healthcare professionals and gaining consent		
Babies and children aged 0-5 years	Parents (including parents who are immigrants* and orthodox Jews) and GPs view GPs as experts, and they agree that there is not enough time allowed in consultations to discuss vaccination satisfactorily. Parents and GPs felt reluctant to initiate discussion about vaccines during consultations because of the rushed nature of general practice, but parents liked being able to ask questions about vaccines. Some parents preferred to seek information at children's centres, where they can discuss vaccines with other parents. * Immigrants include people who had lived in the Netherlands for at least 1 year (mostly people from Morocco, and Turkey, as well as some from Afghanistan, Somalia, Poland and Belgium), and Somali immigrants living in Sweden	

Population to be vaccinated	Finding	Confidence
Incentives aimed at parents or staff		
Babies and children aged 0-5 years	Parents (including orthodox Jews) and commissioners have varying opinions with regards to the acceptability of quasi-mandatory vaccinations. All parents thought that this was preferable to financial incentives and some parents and commissioners agreed that these schemes seem fair and that children who are at risk of transmitting disease should be excluded from school or childcare. However, other parents and commissioners believed that this would not allow free will, would be unfair on the child and could cause greater problems, such as the prosecution of parents. Parents also discussed whether this would cause a divide between parents who could and could not choose to home school there children, as those that could home school would still be able to make a choice about vaccinations.	Moderate
Babies and children aged 0-5 years	Many parents thought that quasi-mandatory vaccination would be useful in day care settings, where children of different ages will be mixing but some of the younger children will not have had all of their vaccinations yet. However, this would not apply to parents of all children because some families do not use day care and so a mandate may not increase vaccination in these children.	Moderate
Babies and children aged 0-5 years	Parents (including ultra-Orthodox Jewish parents) do not like the idea of financial incentives being provided to them in order to encourage vaccination. Almost all parents disagreed with the idea of financial incentives being used to encourage vaccination. Some parents believed that this could cause a divide between rich and poor because richer parents would have more autonomy as they could afford to disregard a financial incentive. However, this incentive could facilitate increased vaccine uptake by parents from lower socioeconomic groups There were some concerns that schemes that provided incentives for parents whose child had yet to be vaccinated was rewarding bad behaviour and could encourage parents to delay their child's vaccinations so that they could receive the incentive. In addition, some parents believed that an incentive scheme would be too costly to administer if it was universal and would be hard to enforce.	Moderate
Babies and children aged 0-5 years	Healthcare professionals think that vaccination targets are unhelpful in certain circumstances but parents (including immigrant parents) do not like them. Some parents felt that advice about vaccines is motivated by money and access to funding instead the child's best interests. They would like payments for meeting vaccination targets to be removed. Health visitors said that targets put them under additional pressure, and they are concerned that children who should be exempted are included in the target population. However, in general they find targets helpful because they are a surrogate for 'health'. GPs said that they are punished by target-setting if they have parents who will not accept vaccines.	High
Process and implementation issues		
Babies and children aged 0-5 years	Health visitors have divided opinions about whether they should be administering vaccinations. Some health visitors have the skills to administer a vaccine, but others do not.	Low
Babies and children aged 0-5 years	Health visitors and parents agree that discussing vaccinations soon after birth is problematic as parents have other priorities at that point. Health visitors said that they are required to discuss vaccinations when the child is 14-28 days old.	High

Population to be vaccinated	Finding	Confidence
	They would like to have additional visits to discuss vaccines. Parents of new babies would like vaccination appointments rearranged to a later date because they are overwhelmed at that stage and unable to think about vaccinations.	
Babies and children aged 0-5 years	Low levels of contact with health visitors during the preschool years (once the child is no-longer a baby) can negatively affect vaccination levels. Parents said that health visitors have a good level of early contact, but this is not the case so once the child is no longer a baby. The lack of contact during the pre-school period leads some parents to question the importance of pre-school vaccines.	Low
Themes that are specific to people with anthroposophical beliefs		
Babies and children aged 0-5 years	Parents with anthroposophical beliefs liked anthroposophic child welfare clinics because they felt that these clinics dedicate more time to informing parents about vaccinations, they could phone them at any time with questions and they perceived the advice they were given as being balanced. [However, it is unclear whether these clinics are facilitators to increase vaccine uptake or whether the lack of pressure to vaccinate had a negative effect on uptake.]	Moderate
Young people aged 11-18 years		
Implementation of the vaccination programme		
Young people aged 11-18 years	Nurses struggle with competing time commitments that reduce their ability to promote and provide vaccinations. Nurses frequently described lacking time to engage fully with the vaccination programme including delivering educational/information sessions and chasing up consent forms. Some nurses provided many different services within schools and felt they lacked the capacity to provide vaccinations as well. Others felt their primary nursing duties suffered when they were dedicating a large portion of their time to delivering vaccines.	High
Young people aged 11-18 years	Having dedicated administrative staff within teams was also viewed as key to effective HPV programme delivery, as were good working relationships within the CHIS team, and between the CHIS and the immunization team.	Moderate
Young people aged 11-18 years	Nurses and school staff felt that nurses were best placed to implement vaccination programmes because they have built a relationship with the school and students. They thought that having a dedicated school nurse improved the vaccination programme and increased uptake.	Moderate
Young people aged 11-18 years	Some nurses felt that schools should take an active role in implementing the vaccination programme by providing staff to attend the vaccination sessions. Having a nominated person was highlighted as important in promoting and facilitating the vaccination sessions and it was helpful to have school staff to collect and supervise the children while they wait for their vaccinations The nurses felt that vaccination was a shared responsibility between themselves and the school staff. They reported that some schools were unsupportive and less willing to facilitate the vaccination programme. In addition, they mentioned that they sometimes encountered difficulties in securing appropriate facilities to run immunisation clinics.	High

Population to be vaccinated	Finding	Confidence
	However, school staff reported difficulties in scheduling time for multiple vaccination clinics in the school calendar and with the minimum disruption to lessons. There were also competing demands on suitable rooms to hold the vaccinations (due to exams for example).	
Young people aged 11-18 years	Teachers and schools can play an important role in communicating information about vaccinations to girls and parents, helping ensure consent forms are completed and that the girls wear suitable clothes to make vaccination easy on the day.	Low
Young people aged 11-18 years	Practice nurses felt unsupported after being delegated responsibility for the Men ACWY catch-up campaign. Other staff either were not aware of the campaign or did not give it priority because it is not a targeted vaccine.	Low
Multiple age/ life stage categories (finding presented in the studies spanning age/ life stage categories section)		
Implementation and delivery		
Multiple age/ life stage categories	The use of financial incentives based on uniform target vaccination rates can discourage effort in areas with harder to reach populations. Financial incentives aimed at increasing providers effort to vaccinate do not reflect differences in populations across the country. They are seen to unfairly penalise providers in underserved communities who may expend a lot of effort but fail to reach the 90% target for childhood vaccination. GPs in other areas may reach targets with much less effort due to their population demographics. This can be discouraging, cause resentment and may lead to reduced effort to increase vaccination.	Moderate
Multiple age/ life stage categories	Healthcare providers reported a number of challenges to achieving vaccination targets. These included: the use of performance targets; vaccine shortages; frequent changes to vaccination schedules and a lack of continuity of care. Performance targets were unpopular with healthcare providers as they led to feelings of stress and powerlessness and reduced their ability to provide more holistic care. Uncertainty around the vaccination schedule was caused by frequent changes in the schedule and the associated changes in information about side effects and this could cause problems when dealing with patient questions. A lack of continuity of care was considered problematic because this can result in incomplete patient records, difficulties in managing vaccination targets and different healthcare professionals (such as pharmacists) may not provide the same level of information and discussion with the patient.	Low
Multiple age/ life stage categories	Appointment times are usually fixed and short which results in rushed discussions between healthcare providers and parents or individuals about vaccinations. As a result, healthcare providers feel pressured and limited in their ability to provide effective care because during these short appointments they may be expected to discuss, gain consent and administer vaccines. This can be exacerbated by communication barriers if the patient is not fluent in English. Romanian and Polish parents also feel rushed and not listened too and this can negatively affect their decision to vaccinate their children.	High
Barriers linked to the re-organisation of the NHS in 2013		

Population to be vaccinated	Finding	Confidence
Multiple age/ life stage categories	Screening and immunisation teams are considered to be an important resource and potential strength of the new system. However, their dual accountability to PHE and NHS England has complicated defining their role and achieving a good balance between commissioning and supporting providers resulting in a lot of variation in how they operate. Many SITs are short staffed and have problems attracting staff, which reduces their ability to performance manage immunisation providers. Strategies used to overcome issues included: NHS England providing SITs with real time immunisation uptake statistics via a data management system, and data sharing agreements to enable LA Public health teams fulfil their assurance responsibilities. There were also a number of ad hoc and sometimes short lived (due to funding constraints) mitigating strategies at local levels: such as a CCG prioritising finding for immunisation and a LA public health team linking SITs with schools and community based children's centres.	Moderate
Multiple age/ life stage categories	There is a huge inconsistency in training provision because it is not clear what role SITs should play in helping ensure that healthcare professionals are trained appropriately. Different approaches are used in different places such as getting local universities to provide essential skills courses for practice nurses, having practice nurses set up monthly training sessions supported by their CCG and a management company.	Moderate
Facilitators from GP practices with high uptake		
Multiple age/ life stage categories	Building positive relationships between medical staff and patients over time was considered to be vital in achieving increased vaccine uptake. The examples cited involved people being offered vaccinations by their 'named GP'; using antenatal appointments with GPs to establish relationships that could improve adherence to postnatal care plans (including vaccinations); providing appointments with child vaccination specialist nurses that allowed sufficient time to address parental concerns and having consultations with homeless people that were not time limited.	Moderate
Multiple age/ life stage categories	Having well trained, designated staff who were up to date with current guidance on vaccinations was linked to increased uptake by staff. The designated individuals, including administrative staff as well as nurses, were responsible for vaccinations and accountable to practice managers. Regular training events and updates on the latest guidance were in place in all practices and having the latest vaccine guidance embedded in the IT system to automatically prompt clinicians was thought to be helpful.	Moderate
Multiple age/ life stage categories	Team-work was highlighted as an important factor in achieving vaccine uptake. This involved a multidisciplinary approach working with colleagues in other fields, such as health visitors who hold baby clinics and visit parents at home to discuss vaccinations and CCG immunisation leads who could provide expertise to answer questions and address concerns. In addition, having an element of competition within and between practices was also linked to increased vaccine uptake.	Moderate
Traveller specific issues (or only raised by Travellers in this section)		
Travellers	Healthcare providers reported a lack of funding to carry out work with Travellers to promote vaccine uptake. This lack of funding affects work with the Roma communities in particular in some areas and may be due to commissioners and senior managers failing to understand the complex nature of working with these communities. Rather than being proactive in	Moderate

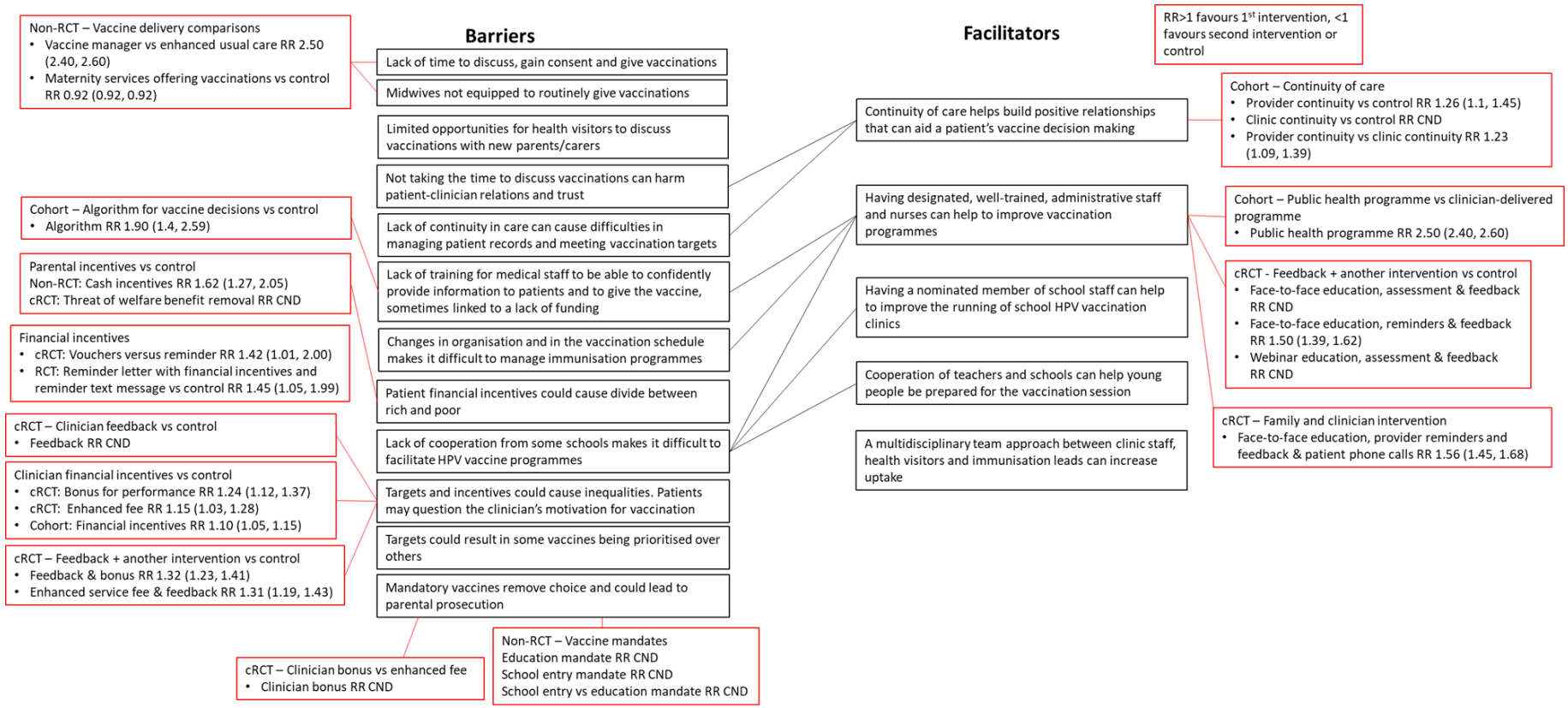
Population to be vaccinated	Finding	Confidence
	trying to address inequalities and promote vaccine uptake routinely, vaccination services are now seen to be more reactive with catch up campaigns in the case of outbreaks. Service providers also raised concerns that there was a lack of fund for training staff carrying out immunisations and schools may be prevented from taking part in immunisation campaigns by the lack of money to provide consent forms in other languages.	
Travellers	NHS reforms have led to system changes that make it hard for healthcare providers to provide vaccinations because teams that are involved in commissioning work do not necessarily have any involvement in its delivery and therefore things like training of staff may be overlooked.	Moderate
Travellers	Continuity of care helps build positive relationships between Travellers and healthcare providers that can be influential in decision making concerning vaccinations. Many Travellers report having positive relationships based on trust and respect that often developed by attending the same GP practice and seeing the same health professionals over a prolonged period of time. However, there were a few accounts of negative encounters with health professionals which had damaged relationships when for example staff did not take time to discuss vaccinations or were judgemental about their decisions. Healthcare providers also noted the importance of continuity of care in building relationships, but that this could be time consuming.	Moderate

1

Mixed methods summary of the quantitative and qualitative evidence

The barriers and facilitators in the diagram are summarised versions of the findings that were considered to be the most important from the qualitative evidence relating to infrastructure presented in Table 17. Possible links between barriers and corresponding facilitators are shown in the diagram, with the quantitative evidence mapped onto the related qualitative themes. See section 1.1.3 Methods and process for more details.

Figure 1 Diagrammatic summary of the barriers and facilitators to vaccine uptake with infrastructure interventions mapped onto them.
RR= risk ratio. CND = could not differentiate.



1.1.7 Economic evidence

A single systematic review was conducted to identify economic evaluations relevant to any of the quantitative review questions in the guideline. The search returned 5,716 records which were sifted against the review protocol. Of these publications 5,669 were excluded based on title and abstract. On full paper inspection 43 studies did not meet the initial inclusion criteria. Inclusion was restricted to cost-utility analyses from OECD countries comparing interventions to increase vaccine uptake for vaccines in the UK immunisation schedule as described in the green book. Four published economic analyses were included in the evidence synthesis.

Due to a lack of cost-utility evidence in children, an additional inclusion set was used to identify studies in children and adolescents (0-18 years), where outcomes were not restricted to QALYs only. An additional six studies from the search were included on this basis to provide evidence in the younger population.

The search was rerun in April 2021 to identify any newly published papers and returned 544 publications, of which 541 were excluded based on title and abstract and two were excluded at the full text inspection. One published economic analysis from this search was included in the evidence synthesis.

1.1.7.1 Included studies

One of the eleven studies looked at an intervention relevant to this review (financial incentives). A summary of this study is given in 1.1.8 Summary of included economic evidence. Detailed information and a quality checklist for this study can be found in Appendix H, and the study selection is described in Appendix G.

All costs and monetary outcomes were uplifted and converted to 2021 GBP using the EPPI Centre cost converter (accessed 08/06/2021), using the IMF PPP dataset.

1.1.7.2 Excluded studies

A list of studies excluded at full text from the cost-effectiveness review can be found in Appendix J.

1.1.8 Summary of included economic evidence

One cost-utility study (conducted in the UK from an NHS perspective) looked at the impact of financial incentives on vaccine uptake in a population of people who use injectable drugs (PWID).

Study	Comparators	Incremental cost	Incremental QALYs	ICER	Uncertainty	Applicability	Limitations
Rafia 2016 UK NHS perspective Contingency management (financial incentives) People who inject drugs	No contingency management	£21.86 (£25.13, 2021 GBP)	0.0032	£6,831.25 (£7,853.93, 2021 GBP)	The economic analysis was most sensitive to the time horizon, the chronicity rate following HBV exposure, the duration individuals remain at increased risk of HBV infection (i.e. remain PWID), the incidence rate for HBV, discount rates for both costs and benefits and the cost associated with training/supervision. The use of contingency management has an 88.51% and 97.60% probability of being considered cost-effective at willingness to pay thresholds of £20,000 and £30,000 per quality-adjusted life years gained, respectively, under the base-case assumptions.	Partially applicable	Minor limitations

1.1.9 Economic model

Original health economic modelling was not prioritised for this review question.

A costing analysis was undertaken for incentivised consent form return and is detailed in evidence review J.

1.1.10 Unit costs

The fees payable to GP providers for delivery each of the vaccines relevant to this guideline are given below.

Resource	Unit costs	Source
Vaccine fee for service (excluding pneumococcal PCV and MMR catch-up)	£10.06	British Medical Association: Vaccinations fees and arrangements
Vaccine fee for service (pneumococcal PCV)	£15.02	British Medical Association: Vaccinations fees and arrangements
Vaccine fee for service (MMR catch-up)	£5	British Medical Association: Vaccinations fees and arrangements

1.1.11 The committee's discussion and interpretation of the evidence

This discussion includes consideration of the qualitative evidence that specifically covers infrastructure from evidence review B (summarised above) as well as the quantitative evidence presented in this review.

1.1.11.1. The outcomes that matter most

The protocol's primary outcome was vaccine uptake. The committee agreed that this outcome was the most important for individuals, their parents and carers (as appropriate), and healthcare professionals because the aim of this guideline is to increase vaccine uptake. None of the included studies reported the protocol's secondary outcomes, which were the proportion of people offered vaccinations and the numbers of people who develop the diseases the vaccines are aimed at preventing. Offers of vaccination was not considered as important as uptake because an offer may not necessarily result in a vaccination.

1.1.11.2 The quality of the evidence

The committee noted that the quality of the quantitative evidence ranged from high to very low as assessed using GRADE. This was due to downgrading for risk of bias due to methodological issues in the ways the studies were designed or carried out, or poor reporting. Many of the studies did not provide information about how data was collected, or they lacked blinding of staff during data collection leading to a risk of bias. In addition, many outcomes were downgraded for imprecision as their 95% CI crossed the line of no effect and they were unable to differentiate between interventions or intervention and control. The evidence was provided by a mixture of RCTs, cluster RCTs, non-randomised or quasi-randomised trials, and cohort studies.

Although the GRADE quality of evidence for Zelman 2014 was low, the effect size was strongly in favour of a public health nurse programme using public health clinics increasing vaccine uptake compared to a family physician delivered programme. However, this study was based in Canada, which has a widely spread-out population in some areas than the UK, and so the committee thought that the evidence was not particularly generalisable to the UK and so the study was downgraded for indirectness. They did note, however, that public health hubs are being used for COVID -19 vaccination in the UK, but this is not currently a routine vaccination.

The committee noted that although vaccine uptake in Llamas 2020 appeared to favour Clinical Commissioning groups (CCGs) that provided pertussis vaccinations through primary care over those who provided pertussis vaccinations using maternity services, solid conclusions could not be drawn because of the low quality of the evidence. In this study, vaccine uptake increased in all of the study groups over time but there were differences in the baseline vaccination rates. The authors also highlighted issues with data reporting, as vaccination uptake was calculated using a system based on primary care records, which would not necessarily have been updated by the maternity services in the intervention arm. As such, the committee did not think they could make recommendations based on this evidence.

There was some evidence examining the effectiveness of using financial incentives or penalties (removal of welfare benefits) targeting individuals, parents, or carers. The evidence could not differentiate the effect on vaccine uptake for removal of benefit compared to control and was low or very low quality. In comparison, cash incentives for vaccination were associated with an increase in HPV uptake, although the evidence was low quality and from a quasi-randomised controlled trial.

1.1.11.3 Advantages and disadvantages

Incentives or penalties aimed at individuals, parents or carers (as appropriate)

The committee discussed the ethics of using financial incentives to increase vaccine uptake. The quantitative evidence suggested this could be effective, particularly for the HPV vaccine where cash incentives increased vaccine uptake in comparison to control (Caskey 2017). In contrast the effect of threats of removal of welfare benefits on vaccine uptake could not be differentiated from control. Financial incentives combined with reminders also resulted in vaccine uptake (Mantzari 2015), but the committee could not determine whether the effect was due to the financial incentives, reminders, or both. Although it appears that financial incentives could increase vaccine uptake, the qualitative evidence was less in favour of this type of intervention, highlighted with parents of 0-5 year old children reporting that they disliked the idea because they thought it could have a greater coercive effect on parents from lower socioeconomic groups who would be more likely to accept the incentive out of financial need than wealthier parents (see the summary of qualitative evidence section above and evidence review B for more details). The committee also had uncertainties around what value of cash incentive would be effective and thought that the amount is likely to vary across areas depending on the socioeconomic status of the population. Such a scheme could be costly (as noted by the parents in the qualitative findings) if it were offered universally and therefore might be better targeted at people in areas of low uptake. The committee noted that without targeting, incentives might be provided to people who would already be willing to vaccinate their child and therefore not be as cost-effective as if they were directed at groups with lower vaccine uptake.

The committee discussed whether incentivising groups with low uptake would be rewarding unwanted behaviour or whether this approach could be an appropriate means of increasing vaccination rates in these groups, and as a result improving equality in society. The use of financial incentives was also viewed negatively by some parents as rewarding parents who failed to vaccinate their children and it was suggested that this could lead to people delaying vaccination to access the reward. The evidence in this review concerned cash incentives, but other, non-financial incentives may also be effective at increasing vaccine uptake. From their experience, one example was a GP surgery organised fun day with events and bike repairs where vaccinations were available.

Considering the weak evidence for effect on vaccine uptake and the uncertainties around the size of the incentive, the committee decided against making a recommendation for the use of financial incentives to increase vaccine uptake. However, they recognised that incentives could be an effective method of increasing uptake and so they made a research recommendation to investigate this further. This is aimed at determining the effectiveness and acceptability of financial and non-financial incentives in the UK (see Appendix K, research recommendation 2). The committee thought it was important that both financial and non-financial incentives are considered, as financial rewards may not be acceptable in some communities. The committee agreed that it is important to consider whether there are specific interventions that would be most effective in populations with low vaccine uptake, as these groups have the potential for the greatest increase in vaccination rates. They did not limit the population in the research recommendation to people in areas of low uptake or to people in groups with low uptake because they wanted to know whether incentives would be effective and acceptable in the wider population as well as in the aforementioned groups. However, as written, the research recommendation could be carried out by focusing on communities with low uptake if the researchers chose to take this approach. In addition, the committee had already written a research recommendation aimed at identifying effective and acceptable interventions targeted specifically at populations identified as having low vaccination uptake (see Appendix K in evidence review B). These could include incentives.

There was additional evidence concerning the use of financial incentives in the evidence review which looked at the acceptability and effectiveness of specific named interventions (evidence review J). This evidence was considered by the committee alongside the evidence in this current review. However, the financial incentives in the review J were linked to consent form return rather than vaccine uptake. The study by Forster 2017 showed that incentivising HPV consent form return could increase the number of consent forms returned. Although this study did not report vaccine uptake, the committee agreed that consent form return could be taken as a proxy for uptake because, in their experience, most of the additional replies would give consent for vaccination rather than refusal (see review J for more information). The committee therefore agreed that incentivising consent form return could be an effective way to promote decision-making for school-based vaccinations and made a recommendation in favour of this (for more information about this recommendation and others concerning gaining consent see evidence review J).

Education and school entry vaccination mandates

Evidence for education and school entry mandates was based in the USA and was limited because many of the identified studies used the same data set and overlapped in time with the included study by Perkins 2016. These were therefore excluded to prevent double counting of results. The HPV education mandate did not increase uptake, and instead marginally higher uptake was seen in the areas without this mandate. However, this evidence was from a low quality cohort study. In addition, the results could not differentiate between HPV school entry vaccination mandate and no vaccination mandate.

The committee discussed the ethics and logistics of using vaccine mandates to increase uptake and decided that the evidence in favour of mandates would have to be very strong if this was to be considered. The evidence from the included study is low to very-low quality and did not show an increase in vaccine uptake with mandation so the committee agreed that there was no evidence currently to support the implementation of vaccine mandates in the UK. They agreed that before mandates could be considered it would also be essential to overcome existing barriers that prevent people from being vaccinated or vaccinating their children, such

as problems with accessing vaccination services; a lack of balanced, reliable information and the ability to discuss it with providers when needed.

School entry mandates might be particularly hard to implement as they may not be enforceable in private and independent schools. These differences could create inequalities as some people will be able to make decisions about vaccinations if the mandate does not apply to their school or if they are able to home school or move their children to a different school, Other people who do not have these options will be subject to the mandate to access education. The committee also expected that such a mandate would be very unpopular and could cause a public backlash against vaccination. The qualitative findings reported mixed views about quasi-mandatory vaccinations. Some parents supported the use of these schemes as a means of ensuring that their child is surrounded by other vaccinated children and noted that this was especially important at places like nurseries where some children are too young to be vaccinated but could still be infected. It was suggested that this will also help to protect children who could not be vaccinated for medical reasons. In contrast, other parents believed that a mandate would remove free will, would be unfair on the child if they were excluded from school due to the refusal of their parents to allow vaccination and could increase inequalities as discussed above, or even lead to the prosecution of parents. Finally, the committee noted that mandatory HPV vaccination should not be necessary because the UK has one of the highest HPV vaccination uptakes in the world: Public Health England reported that 83.9% of Year 9 girls completed the 2-dose HPV vaccination course in 2018/19. They also noted that in Italy, the introduction of a mandate for certain vaccinations has actually had the unintended consequence that non-mandatory vaccines were perceived to be less important (Bonanni 2001).

Although the committee decided against making a recommendation for mandatory vaccination, they recognised that there is currently limited evidence on this type of intervention. For this reason, they decided to include a research recommendation to examine the effectiveness and acceptability of quasi-vaccine mandates in the UK (see Appendix K, research recommendation 3). This should provide more detailed quantitative and qualitative evidence on which to judge the impact of vaccine mandates when making recommendations in future guideline updates.

Incentives for providers

Data from Fairbrother 1999 showed that vaccine uptake was increased when providers were given bonuses for performance or enhanced fees for service in comparison to control. Gavagan 2010 also showed that financial incentives for physicians increased uptake compared to control. The committee agreed that financial payments could incentivise providers to increase their efforts to vaccinate people. They noted that in the UK, GPs already receive payment for vaccinations to cover the cost of the vaccination and the time taken to identify eligible people, invite them to for vaccination, and administer the vaccinations. There are additional payments for vaccinations available under the Quality and Outcome Framework (QoF) if certain conditions are met, such as vaccinating 90-95% of children who reached 18 months old in the preceding 12 months with at least one dose of MMR (Annex A: new QOF indicators for 2021/22). However, the committee noted that in some areas it may be much harder to obtain the level of vaccination needed to trigger a reward because they may contain larger numbers of people who are difficult to reach, such as those in more deprived areas or with larger immigrant communities who do not speak English. This may be discouraging for these providers as they may need to expend a lot more effort to obtain a lower vaccination rate than providers in other areas with higher baseline rates of uptake. Issues about the use of uniform target vaccination rates to access incentives and the difficulties of reaching

vaccination targets were also apparent in the qualitative findings. The committee noted that adapting the point at which the rewards are available to take this into account could incentivise providers in areas of low uptake, but the QoF targets are set nationally by NHS England. The qualitative findings also highlighted that some parents felt that vaccination targets meant that providers' advice about vaccines was motivated by money. These parents therefore thought that payments for meeting vaccination targets should be removed. This would prevent any conflict of interest affecting the advice given by the provider. Given the limited evidence on incentives for providers; that provider incentives are subject to change and it is unclear what types and levels of incentives are most effective in the UK, the committee decided to include a research recommendation to identify whether there are any types of provider-based incentives that could result in increased immunisation rates in the UK (see Appendix K, research recommendation 1). The committee decided that research should evaluate both the effectiveness and acceptability of these types of interventions because the acceptability of the interventions may impact their effectiveness and differ between areas of lower and higher vaccine uptake as raised in the qualitative evidence mentioned above.

The committee discussed the importance of raising awareness among providers and healthcare staff about funding linked to vaccination, and about how submission of vaccine uptake information is linked to incentive payments. It was highlighted that, in the committee's experience, staff and providers may not always be aware of all the funding streams available to them in relation to vaccination. This is particularly important for areas with low vaccination rates, where promoting vaccination may require more time and resources, and therefore require more funding. The committee therefore decided that, rather than recommend new provider incentives, it was important to ensure that existing revenue streams and incentives are widely known about so that all providers can benefit from them.

Although the committee agreed that incentives for vaccinations are an important mechanism to increase provider effort to vaccinate their patients, they also discussed that targets for some vaccinations could inadvertently result in them being prioritised over other vaccines despite them all being equally important from the individual patient and public health point of view. This was supported by findings from the qualitative review (see review B) that practice nurses felt unsupported by other staff when implementing a catch-up campaign for the Men ACWY vaccine, which was not a targeted vaccination. A recommendation was therefore included to highlight to commissioners that providing incentives for certain vaccinations could have unintended consequences on other vaccinations and that this should be taken into account when designing incentive schemes.

Audit, monitoring and feedback

Studies with data for interventions that included feedback aimed at providers had mixed results compared to control (Gilkey 2014, Gilkey 2019, Fairbrother 1999). An additional study in the multicomponent review (see evidence review H - Fiks 2013) used a provider intervention which included audits and feedback and resulted in greater vaccine uptake than control. The committee therefore used a combination of this evidence and their clinical experience to make two recommendations on audits and feedback. The first is a recommendation for commissioners to provide a system which enables regular feedback and audits. This is important so that providers can be aware of their own activity and compare their activity against other similar providers. By using this, providers should be able to develop practices for continuous improvement and potentially share examples of good practice or effective interventions with similar providers. The committee also decided to recommend that

feedback should be produced quarterly to ensure that there is regular, up to date, information available to practices.

1.1.11.4 Cost effectiveness and resource use

One cost-effectiveness study was identified for infrastructure interventions. However, the committee felt that it was not directly applicable to the UK routine vaccination programme because of the population and intervention (as it was specifically in the subset of people who use injectable drugs, and looked at hepatitis B vaccination, which at the time was not on the routine UK schedule for the general population), and therefore the study was not used when making recommendations. The committee made recommendations on the effectiveness evidence presented for infrastructure interventions and, in the absence of applicable economic evidence, used their expertise to inform discussion around the expected resource impact of these recommendations.

In the discussion about payments for vaccination services the committee noted that it is not always clear to providers what funding streams are available to support vaccine delivery, or what information about vaccine uptake needs to be submitted to receive organisational incentive payments. The committee recommended that vaccination commissioners should raise awareness of these payments and funding streams among healthcare staff and providers. This recommendation is unlikely to require any additional resources, as this awareness could be done in existing communications between commissioners and providers, and the funding streams already exist.

Based on the clinical evidence, the committee made recommendations on audits and feedback for vaccine providers. The committee recommended that commissioners ensure a coordinated system is in place for quarterly feedback and audits for providers to compare against other similar providers at a local and national level. Additionally, the committee recommended that providers use the available data to review their activity to promote continuous improvement. Feedback and review is current practice in some local areas and the data on vaccine uptake is already reported, however for this to be done consistently and regularly there may be an administrative cost associated with the compiling of these feedback reports, but this cost is anticipated to be small.

1.1.11.5 Other factors the committee took into account

Future proofing the recommendations

In the evidence reviews we looked for evidence regarding routine vaccinations for people aged 65 and over because this was the age limit for vaccinations for older people on the NHS routine schedule at the time the work was carried out. Since there was limited evidence for this age group, we also included data from relevant studies including people aged 50 and over, where the majority of participants were in our target age group, or the mean age was 65 or over with committee agreement taken on a review-by-review basis. These studies were downgraded for applicability where the committee deemed it appropriate.

According to the Joint Committee on Vaccination and Immunisation minutes from the meeting on 22 June 2021, shingles vaccination eligibility is changing to include people aged 60 and over and this will be introduced in a phased manner down from the current age of 70 years. It is unclear when this change will be initiated or completed. In order to future proof the guideline recommendations we have therefore changed those mentioning people aged 65 and over to refer to older people instead

and defined them as follows: adults who are eligible for routine vaccination on the UK schedule, excluding pregnancy-related vaccinations. We also suggest that people consult the green book for information about current age limits and vaccinations for older people. The content of the recommendations has not been changed otherwise as this was not deemed necessary. The majority of recommendations that apply to older people are also more generally applicable and have not been altered because they do not mention groups of people by age. The committee discussions of the evidence have also been retained in their original form, with the addition of the information about the use of the term older people where the relevant recommendations that specifically mentioned people aged 65 and over are discussed.

1.1.12 Recommendations supported by this evidence review

This evidence review supports recommendations 1.1.5-1.1.6 and 1.1.14-1.1.15 and the research recommendation on incentives for providers; quasi-mandation of vaccination and incentives for eligible individuals, their family members or carers (as appropriate. Other evidence supporting these recommendations can be found in the evidence reviews on the barriers to and facilitators for vaccine uptake (evidence review B); and for the use of multicomponent interventions to increase vaccine uptake (evidence review H).

1.1.13 References – included studies

1.1.13.1 Effectiveness

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1.1.13.2 Economic

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1.1.13.3 Other

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6

Appendices

Appendix A – Review protocols

Review protocol to identify effective interventions to improve uptake of routine vaccines.

ID	Field	Content
0.	PROSPERO registration number	Not applicable
1.	Review title	Identifying effective interventions to improve uptake of routine vaccines.
2.	Review questions	What are the most effective interventions for increasing the uptake of routine vaccines?
3.	Objectives	To identify effective strategies to improve routine vaccine uptake.
4.	Searches	The following databases will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE • Medline in process • Medline epubs ahead of print • Emcare • Psycinfo • Sociological Abstracts • ASSIA • DARE • Econlit (economic searches) • NHS EED (economic searches) • HTA (economic searches) • Other subject specific databases as appropriate for the quantitative review Searches will be restricted by: • Studies published since 1990 • English language • Human studies • Qualitative, Systematic Review, RCT, OECD geographic filters as appropriate Other searches: • Reference searching where appropriate

		• Citation searching where appropriate • Inclusion lists of systematic reviews • Websites where appropriate The searches will be re-run 6 weeks before final submission of the review and further studies retrieved for inclusion. The full search strategies for MEDLINE database will be published in the final review.
5.	Condition being studied	Uptake of vaccines on the routine NHS schedule
6.	Population	Inclusion: • All people who are eligible for vaccines on the routine UK immunisation schedule and their families and carers (if appropriate). • Staff including, but not limited to, those providing advice about or administering vaccines and those people with relevant administrative or managerial responsibilities. Exclusion: None
7.	Interventions and factors of interest	Interventions including, but not confined to: 1. Information, education and methods of communicating them: Interventions to provide information including: • online campaigns including social media and apps • radio campaigns • letters by mail • printed materials (e.g. leaflets) • multi-media campaigns • TV and online advertising (including pop up adverts) • posters • online information exchange- fill in questionnaire and get information Educational interventions (delivery methods): • face-to-face sessions • telephone conversations • social media with responses • interactive multi-media interventions (e.g. case studies on GP websites; e-learning) • interactive community events (e.g. talks with question and answer sessions) • peer education (carried out by a community member who shares similar life experiences to the community they are working with)

		• lay education (carried out by community members working in a non- professional capacity)
		• multicomponent interventions targeting education
		• vaccine hotlines and special advisory clinics for health professionals
		
		Who provides the information and/or advice and how they do so, including:
		• Vaccine champions:
		  ○ Practitioners
		  ○ Peers
		  ○ Community leaders
		• Interventions to train staff and other people on how best to communicate the information/ run educational sessions.
		• Recommendations to vaccinate from people/groups including:
		  ○ Medical and other staff (for example, GPs, nurse, health visitors, midwives,)
		  ○ Social workers
		  ○ Community leaders
		  ○ Religious leaders
		  ○ Peers
		  ○ Teachers
		
		Information and education can be provided during home visits, during interactions with health and social care workers, at support group meetings for people using other services etc. This may involve providing a contact point for more information.
		
		Types of information include PHE bulletins and local bulletins for providers.
		
		2. Vaccination reminders aimed at providers or individuals including:
		
		Reminder and recall systems (aimed at provider)
		• clinical alerts and prompts
		• national alerts to local teams
		• local recall initiatives
		
		Personal invitation to be vaccinated from:
		• GP
		• community pharmacist
		• health or social care worker
		• from several professionals
		
		Reminders to individuals/ eligible groups by:
		• text messages
		• electronic invitations (via apps)

		• emails • letter • phone calls • posters • postcards 3. Interventions targeting acceptability: • Alternative forms of vaccinations (e.g. injections, formulations) • Alternative settings • Alternative vaccine providers (e.g. doctor administering vaccine instead of nurse) 4. Interventions to improve access including: Expanding access in healthcare, such as: • Reducing distance/time to access vaccinations • Out of hour or drop-in services • Delivering vaccines in clinical settings in which they were previously not provided Vaccination clinics in community settings: • community pharmacies • antenatal clinics • specialist clinics (e.g. drug and alcohol services, mental health services) • community venues (e.g. libraries, children's centres) Dedicated clinics for specific/ all routine vaccinations: • Mass vaccination clinics in community or other settings (e.g. schools) • Walk in or open access immunisation clinics Extended hours clinics • weekends evenings (after 6 pm) • early mornings (before 8 am) • 24-hour access Outreach interventions or mobile services: • home or domiciliary or day centre visits • support group meeting visits • residential or care home visits • special school visits • inpatient visits • custodial visits • immigration settings • mobile clinics (e.g. in community) Parallel clinics

		• Offer vaccination in parallel with regular appointments (e.g. with midwives, clinicians, inpatient and outpatient clinics, long stay wards, etc.) • coordinated timing of other programmes (such as child developmental checks) Opportunistic vaccinations: • visits to GP, practice nurse or consultant for other medical conditions including STI clinics, drug and alcohol programmes • having vaccinations provided in hospitals or accident and emergency departments • may involve a dedicated person to administer the vaccines. 5. Interventions to improve infrastructure (targeting processes, staffing and settings): Booking systems • dedicated vaccination lines or online systems Organisation of local provider-based systems: • Local area approaches • Systems and processes in place to work with the community • Practice level approaches • Assigned lead for a specific vaccination programme • Having staff who are competent to deliver vaccinations available in multiple settings • Having staff with responsibilities for training practitioners, answering complex questions, co-ordinating immunisations etc. Systems involved in the recording and identification of eligibility and status (covered in RQ1- see this review protocol for a list of potential interventions) Incentives based interventions: • Incentive (and disincentives for not vaccinating) schemes (for individuals) o voucher schemes (not to cover cost of vaccination or healthcare) o payment to cover travel costs o fines/ penalties for not vaccinating o entry to childcare settings/ schools blocked in the absence of proof of vaccination status • Mandatory vaccination • Incentive schemes (for providers) o targets

		○ quality and outcomes framework ○ voucher schemes Audit and feedback on uptake rates for providers • Weekly statistics • Content and delivery of feedback • Practical relevance (e.g. how many more people need to be vaccinated to achieve a target number) • Comparison data (e.g. between GP practices) 6. Multicomponent interventions: • Interventions which include more than one component and target multiple issues (for example the intervention could include an educational component and changes in the timing of clinics) will be analysed separately, but with other similar multicomponent interventions where possible. • Multicomponent interventions which include more than one component that is targeting a single issue will be included in the relevant category instead.
8.	Comparators	• Usual approaches to increase vaccine uptake • Other interventions to increase vaccine uptake ○ Other interventions targeting same issue/ theme (for example education) ○ Other interventions targeting different issues/ theme (for example education versus infrastructure)
9.	Types of study to be included	Systematic reviews of included study designs. Then as needed: • Randomised controlled trials • Non-randomised controlled trials • Controlled before-and-after studies • Interrupted time series • Cohort studies • Before and after studies • Mixed method study designs (quantitative evidence that matches the above study designs only) For the mixed methods synthesis, published mixed methods studies will also be included if the study does not present quantitative and qualitative evidence separately, but only if the individual study designs meet the inclusion criteria for both the qualitative and quantitative reviews as detailed above.
10.	Other exclusion criteria	Interventions to increase uptake of these vaccines/ conditions: • Selective immunisation programmes, as defined in the Green Book and additional vaccines for people with underlying medical conditions because they do not form part of the routine schedule.

		• Seasonal vaccinations because they are not part of the routine vaccination schedule, apart from Flu, which is covered by a separate NICE guideline and excluded for this reason (see section 14 for reasons underlying a possible deviation from this exclusion). • Travel vaccines- not on routine schedule • Areas covered by NICE's guideline on tuberculosis. • Catch-up campaigns alongside the introduction of a new vaccine Only papers published in the English language will be included. Where studies from the USA (or other countries with similar health insurance-based systems) are included in the qualitative reviews any barriers/ facilitators relating to financial incentives (such as payment for vaccines or affording health insurance) will not be recorded as these are not relevant for the UK. In addition, in countries where vaccines or health care are paid for by the user studies looking at any financial incentive-based interventions are excluded.
11.	Context	The Department of Health and Social Care in England has asked NICE to produce a guideline on vaccine uptake in the general population. In recent years, UK vaccination rates have declined, resulting in increases in vaccine preventable diseases, particularly measles. There were 991 confirmed cases in England in 2018 compared with 284 in 2017 and the World Health Organization no longer considers measles 'eliminated' in the UK. Reasons for low uptake include poor access to healthcare services; inaccurate claims about safety and effectiveness, which can lead to doubts about vaccines; and insufficient capacity within the healthcare system for providing vaccinations. In addition, problems with the recording of vaccination status and poor identification of people who are eligible to be vaccinated may have contributed to this problem.
12.	Primary outcomes (critical outcomes)	Changes in: • Vaccine uptake (overall for a specific vaccine or vaccines and for each dose where a vaccine is administered in multiple doses)
13.	Secondary outcomes (important outcomes)	Changes in: • the proportion of people offered vaccinations • the numbers of people who develop the disease the vaccination was aimed at preventing

14.	Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI reviewer and de-duplicated. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. The quantitative systematic review search results will be sifted using the EPPI reviewer priority screening functionality, but the whole data base will still be screened in each case. However, when sifting for primary studies for specific sections of the quantitative review priority screening may be used to terminate screening before the end of the search is reached. In this case, at least 50% of the identified abstracts will be screened. After this point, screening will only be terminated if a pre-specified threshold of 500 references is met for a number of abstracts being screened without a single new include being identified. A random 10% sample of the studies remaining in the database when the threshold is met will be additionally screened, to check if a substantial number of relevant studies are not being correctly classified by the algorithm, with the full database being screened if concerns are identified. The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. Data will be extracted from the included studies into a standardised form (see Developing NICE guidelines: the manual section 6.4) for assessment of study quality and evidence synthesis. Extracted information for the quantitative review will include: study type; study setting; study population and participant demographics and baseline characteristics; details of the intervention and comparator used; study methodology; inclusion and exclusion criteria; recruitment and study completion rates; outcomes and times of measurement and information for assessment of the risk of bias. If insufficient evidence is identified to make recommendations, we will consult the committee and consider a call for evidence (as detailed in the NICE manual) or include more indirect evidence from other relevant guidelines (for example, the NICE flu guideline).
15.	Risk of bias (quality) assessment	Risk of bias will be assessed using appropriate checklists as described in Developing NICE guidelines: the manual. Systematic reviews will be assessed using the ROBIS checklist. For the quantitative review, randomised controlled trials will be assessed using the Cochrane risk of bias v2.0 checklist. Non-randomised controlled trials and cohort studies will be assessed using the Cochrane ROBINS-I checklist. Controlled/ uncontrolled before and after

		studies, and interrupted time series will be assessed using the EPOC tool. Any mixed methods studies with quantitative data that can be extracted separately will be assessed using ROBINS-I, Cochrane risk of bias v2.0, or EPOC appropriate. Mixed methods studies where separate quantitative and qualitative data cannot be assessed separately will be assessed using the mixed methods appraisal tool (2018 version).
16.	Strategy for data synthesis	A mixed methods approach will be used to address this topic area. The quantitative and qualitative reviews (evidence review B) will be conducted separately (segregated study design) but at the same time. The evidence from the reviews will then be analysed in relation to each other (convergent synthesis of results). (See below for more details. The findings will **not** be integrated by transforming one type of evidence into the other (e.g. quantitative findings into qualitative findings). Where possible, meta-analyses of outcome data will be conducted for all comparators that are reported by more than one study, with reference to the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al. 2011). Data will be separated into the groups identified in section 17. Continuous outcomes will be analysed as mean differences, unless multiple scales are used to measure the same factor. In these cases, standardised mean differences will be used instead. Pooled relative risks will be calculated for dichotomous outcomes (using the Mantel–Haenszel method) reporting numbers of people having an event. Absolute risks will be presented where possible. Fixed- and random-effects models (der Simonian and Laird) will be fitted for all comparators, with the presented analysis dependent on the degree of heterogeneity in the assembled evidence. Fixed-effects models will be deemed to be inappropriate if one or both of the following conditions is met: • Significant between study heterogeneity in methodology, population, intervention or comparator was identified by the reviewer in advance of data analysis. • The presence of significant statistical heterogeneity in the meta-analysis, defined as $I^2 \geq 50\%$.

		In any meta-analyses where some (but not all) of the data comes from studies at high risk of bias, a sensitivity analysis will be conducted, excluding those studies from the analysis. Results from both the full and restricted meta-analyses will be reported. Similarly, in any meta-analyses where some (but not all) of the data comes from indirect studies, a sensitivity analysis will be conducted, excluding those studies from the analysis. GRADE will be used to assess the quality of the outcomes. Outcomes using evidence from RCTs, non-randomised trials and cohort studies will be rated as high quality initially and downgraded from this point. Controlled before and after studies and interrupted time series will be rated as low quality initially. Reasons for upgrading the certainty of the evidence will also be considered. Where 10 or more studies are included as part of a single meta-analysis, a funnel plot will be produced to graphically assess the potential for publication bias. Meta-analyses will be carried out separately for each study type per outcome, but the similarities and differences between the results obtained from the different study types will be noted. <u>Synthesising the findings of mixed method reviews.</u> Where mixed methods studies are identified that present data in a form that cannot be extracted and analysed separately as quantitative and qualitative data (in evidence review B), the results of the studies will be reported separately for each study. Any correlations or discrepancies between the findings of the mixed methods studies and the syntheses of the quantitative and qualitative findings of the above analyses will be noted. <u>Mixed method synthesis of findings from the quantitative and qualitative reviews</u> Where appropriate, a synthesis matrix will be produced to combine results from the different individual analysis methods. Findings from one analytical approach will be compared to findings from the second approach, and outcomes paired up if they provided relevant information on the same underlying topic. The agreement between the findings of the two approaches will be qualitatively assessed, with each paired set of findings put into one of the three categories relating to the strength of the identified correlation. The results may be presented as a concept diagram with quantitative findings mapped onto the qualitative ones if this is thought to be informative.

17.	Analysis of sub-groups	Results will be separated into the following for analysis:
		
		• Age/time when vaccine is due:
		  o During pregnancy
		  o 0-5 years
		  o 11 to 18 years
		  o 65 years and older
		
		• Population groups with potential equality issues:
		  o Children excluded from mainstream education (including pupil referral units) and non-attenders.
		  o Care home residents or people in long-term care
		  o Looked after children
		  o Religious groups or groups with special beliefs (e.g. anthroposophical views)
		  o Travellers/ gypsies
		  o Migrants and asylum seekers
		
		• Settings:
		  o care homes (covered above for residents)
		  o hospitals
		  o community versus healthcare
		  o educational settings
		
		• Mandatory versus partially mandatory, opt-outs allowed or completely optional vaccine schedules
		
		• Numbers of doses of vaccines
		
		• Study type: RCT, non-randomised studies (NRTs, CBA, ITS)
		
		• Interventions that are part of a catch-up campaign versus interventions that are not part of a catch-up campaign
		
		• System levels:
		  o health system level (for example clinical commissioning group [CCG], local authority, regional and national level)
		  o service provider level (for example GP practices, practitioners)
		  o individual level (for example patients or service users including carers)
		  o mixed levels
		
		• For interventions that use information/ education to increase uptake the results will also be presented for generic versus tailored interventions.

		☒ Intervention (multicomponent review)

18.	Type and method of review	☐ Diagnostic ☐ Prognostic ☐ Qualitative ☐ Epidemiologic ☐ Service Delivery ☒ Mixed method (all other quantitative reviews)		
19.	Language	English		
20.	Country	England		
21.	Anticipated or actual start date	January 2020		
22.	Anticipated completion date	October 2021		
23.	Stage of review at time of this submission	**Review stage**	**Started**	**Completed**
		Preliminary searches	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
		Piloting of the study selection process	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
		Formal screening of search results against eligibility criteria	☑ ☑ ☑ ☑	☐ ☐ ☐ ☐
		Data extraction	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
		Risk of bias (quality) assessment	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐

		Data analysis	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
24.	Named contact	**5a. Named contact** Guideline Updates Team **5b Named contact e-mail** VaccineUptake@nice.org.uk **5e Organisational affiliation of the review** National Institute for Health and Care Excellence (NICE)		
25.	Review team members	From the Guideline Updates Team: • Marie Harrisingh • Toby Mercer • Stephen Sharp • Hannah Lomax • Joshua Pink • Elizabeth Barrett		
26.	Funding sources/sponsor	This systematic review is being completed by the Guideline Updates Team which receives funding from NICE.		
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.		
28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/indevelopment/gid-ng10139		
29.	Other registration details	None		

30.	Reference/URL for published protocol	None
31.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.
32.	Keywords	Vaccine uptake, NHS routine vaccination schedule, interventions and barriers and facilitators.
33.	Details of existing review of same topic by same authors	None
34.	Current review status	☒ Ongoing ☐ Completed but not published ☐ Completed and published ☐ Completed, published and being updated ☐ Discontinued
35..	Additional information	None
36.	Details of final publication	www.nice.org.uk

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Appendix B – Literature search strategies

Systematic review search

An initial search to find systematic reviews identifying interventions to improve uptake of routine vaccinations was run on 23rd and 24th March 2020 and re run on 5th and 6th May 2021.The following databases were searched: Medline, Medline in Process, Medline epubs ahead of print, Embase, Emcare and Psycinfo (all via the Ovid platform), Cochrane Database of Systematic Reviews (via the Wiley platform), Database of Abstracts of Reviews of Effects (DARE, via the Centre for Reviews and Dissemination platform), Applied Social Sciences Index and Abstracts (ASSIA), British Nursing Index, Sociological Abstracts and Educational Resources Information Center (ERIC, all via the Proquest platform). The Medline strategy is shown below. health-evidence.ca study design filters were applied where appropriate. The search was limited to studies published after 1990 in the English language.

1 exp Vaccination/
2 exp vaccines/
3 exp Immunization programs/
4 vaccin*.tw.
5 exp Immunization/
6 (immunis* or immuniz*).tw.
7 (immunologic* adj4 (sensitiz* or sensitis* or stimulation*)).tw.
8 (immunostimul* or variolation*).tw.
9 or/1-8
10 (uptake or ((increas* or improv* or rais* or higher) adj8 (rate* or immuni* or vaccin* or complian*))).tw.
11 9 and 10
12 (MEDLINE or pubmed).tw.
13 systematic review.tw.
14 systematic review.pt.
15 meta-analysis.pt.
16 intervention$.ti.
17 or/12-16
18 11 and 17
19 animals/ not humans/
20 18 not 19
21 limit 20 to english language
22 limit 21 to ed=19900101-20200323

Common terms for primary studies searches

Focussed searches were run to identify evidence on themed groups of interventions between June 2020 and February 2021 to supplement systematic reviews retrieved by the overarching systematic review search. These were re run in April 2021.

The Medline version of the population terms used in all searches is shown below.

1 Diphtheria/
2 diphtheria*.tw.
3 Tetanus/
4 (tetanus or tetani).tw.
5 Whooping Cough/

6 (pertuss* or "whooping cough").tw.
7 Haemophilus influenzae type b/
8 ("Haemophilus influenza* type b" or "Hemophilus influenza* type b" or hib).tw.
9 Hepatitis B/
10 "hepatitis b".tw.
11 exp Poliomyelitis/
12 (Polio* or (infantile adj1 paralysis)).tw.
13 exp Pneumococcal Infections/
14 (Pneumococcal adj4 (disease* or infection*)).tw.
15 (streptococcus pneumoniae adj4 Infection*).tw.
16 exp Meningococcal Infections/
17 (Meningococcal adj4 (disease* or infection*)).tw.
18 Rotavirus Infections/ or Rotavirus/
19 rotavirus.tw.
20 Measles/
21 (measles or rubeola or mmr).tw.
22 Mumps/
23 (mumps or (epidemic adj2 (parotitides or parotitis))).tw.
24 Rubella/ or Rubella virus/
25 (rubella or ((german or "three day") adj2 measle*)).tw.
26 human papillomavirus 16/ or human papillomavirus 18/ or exp papillomavirus Infections/ or exp human papillomavirus 11/
27 (hpv or papillomavirus).tw.
28 Condylomata Acuminata/
29 (condyloma* adj1 acuminat*).tw.
30 ((genital or veneral) adj2 wart*).tw.
31 exp Herpes Zoster/
32 (shingles or herpes zoster or zona).tw.
33 or/1-32
34 exp Vaccination/
35 Vaccines/ or exp bacterial vaccines/ or cancer vaccines/ or exp toxoids/ or exp viral vaccines/
36 exp Immunization programs/
37 vaccin*.tw.
38 exp Immunization/
39 (immunis* or immuniz*).tw.
40 (immunologic* adj4 (sensitiz* or sensitis* or stimulation*)).tw.
41 (immunostimul* or variolation*).tw.
42 or/34-41
43 33 and 42
44 exp Diphtheria toxoid/ or exp tetanus toxoid/ or Haemophilus Vaccines/ or meningococcal Vaccines/ or exp Pertussis Vaccine/ or exp Streptococcal vaccines/ or exp Vaccines Combined/ or exp Measles vaccine/ or exp Mumps Vaccine/ or exp papillomavirus vaccines/ or exp Poliovirus Vaccines/ or Rotavirus Vaccines/ or exp Rubella Vaccine/ or Hepatitis B vaccines/ or Herpes Zoster Vaccine/ (65237)
45 43 or 44

A NICE in house geographic filter to limit studies to OECD countries was applied where appropriate. The Medline version is shown below

1. afghanistan/ or exp africa/ or albania/ or andorra/ or antarctic regions/ or argentina/ or exp asia, central/ or exp asia, northern/ or exp asia, southeastern/ or exp atlantic islands/ or bahrain/ or bangladesh/ or Bhutan/ or bolivia/ or borneo/ or "bosnia and herzegovina"/ or brazil/ or bulgaria/ or exp central america/ or exp china/ or "commonwealth of independent states"/ or croatia/ or "democratic people's republic of korea"/ or ecuador/ or gibraltar/ or guyana/ or exp india/ or indonesia/ or iran/ or iraq/ or jordan/ or kosovo/ or kuwait/ or

lebanon/ or liechtenstein/ or macau/ or "macedonia (republic)"/ or exp melanesia/ or moldova/ or monaco/ or mongolia/ or montenegro/ or nepal/ or netherlands antilles/ or new guinea/ or oman/ or pakistan/ or paraguay/ or peru/ or philippines/ or qatar/ or "republic of belarus"/ or romania/ or exp russia/ or saudi arabia/ or serbia/ or sri lanka/ or suriname/ or syria/ or taiwan/ or exp transcaucasia/ or ukraine/ or uruguay/ or united arab emirates/ or exp ussr/ or venezuela/ or yemen/
2. "organisation for economic co-operation and development"/
3. australasia/ or exp australia/ or austria/ or exp baltic states/ or belgium/ or exp canada/ or chile/ or czech republic/ or colombia/ or europe/ or exp france/ or exp germany/ or greece/ or hungary/ or ireland/ or israel/ or exp italy/ or exp japan/ or korea/ or luxembourg/ or mexico/ or netherlands/ or new zealand/ or north america/ or poland/ or portugal/ or exp "republic of korea"/ or exp "scandinavian and nordic countries"/ or slovakia/ or slovenia/ or spain/ or switzerland/ or turkey/ or exp united kingdom/ or exp united states/
4. european union/
5. developed countries/
6. or/2-5
7. 1 not 6

The following study designs were applied where appropriate. Medline versions are shown below.

Randomised controlled trials

McMaster balanced filter

1. randomized controlled trial.pt.
2. randomi?ed.mp.
3. placebo.mp.
4. or/1-3

Systematic reviews

health-evidence.ca filter

1. (MEDLINE or pubmed).tw.
2. systematic review.tw.
3. systematic review.pt.
4. meta-analysis.pt.
5. intervention$.ti.
6. or/1-5

Observational studies

Adapted from the NICE in house filter

1. Observational Studies as Topic/
2. Observational Study/
3. Epidemiologic Studies/
4. exp Cohort Studies/
5. Controlled Before-After Studies/
6. Interrupted Time Series Analysis/
7. Comparative Study.pt.
8. (cohort adj (study or studies)).tw.
9. cohort analy$.tw.
10. (follow up adj (study or studies)).tw.

11. (observational adj (study or studies)).tw.
12. longitudinal.tw.
13. prospective.tw.
14. retrospective.tw.
15. or/1-14

Searches were limited to studies published after 1990 in the English language.

Reminder Interventions search

Searches were run on various dates between 26th June and 28th July 2020 and re run on 9th April 2021 in the following databases: Medline, Medline in Process, Medline epubs ahead of print, Embase, Emcare and Psycinfo (all via the Ovid platform), CENTRAL and the Cochrane Database of Systematic Reviews (via the Wiley platform), Database of Abstracts of Reviews of Effects (DARE, via the Centre for Reviews and Dissemination platform), Applied Social Sciences Index and Abstracts (ASSIA), British Nursing Index, and Sociological Abstracts (all via the Proquest platform). The Medline version of the intervention terms are shown below. Population terms, the OECD geographic filter, RCT, systematic review and observational study design filters as described above were used.

1. Reminder Systems/
2. (recall or remind* or prompt* or nudge).tw.
3. (electronic* adj4 invit*).tw.
4. Mobile Applications/
5. exp Internet/
6. exp Cell Phone/
7. exp Computers, Handheld/
8. (app or apps).ti,ab.
9. (online or web or internet or digital*).ti.
10. ((online or web or internet or digital*) adj3 (based or application* or intervention* or program* or therap*)).ab.
11. (phone* or telephone* or smartphone* or cellphone* or smartwatch*).ti.
12. ((phone* or telephone* or smartphone* or cellphone* or smartwatch*) adj3 (based or application* or intervention* or program* or therap*)).ab. (8053)
13. (mobile health or mhealth or m-health or ehealth or e-health or emental or e-mental).ti.
14. ((mobile health or mhealth or m-health or ehealth or e-health or emental or e-mental) adj3 (based or application* or intervention* or program* or therap*)).ab.
15. (mobile* adj3 (based or application* or intervention* or device* or technolog*)).ti,ab.
16. text messaging/
17. (text messag* or sms or short messag* service).tw.
18. electronic mail/
19. (email* or e-mail* or e mail* or electronic mail).tw.
20. Correspondence as Topic/
21. (letter* or correspondence or mail).tw.
22. (iphone* or mobile phone*).tw.
23. pamphlets/
24. (pamphlet* or leaflet* or brochure*).tw.
25. Posters as Topic/
26. poster*.tw.
27. (postcard* or post-card*).tw.
28. or/1-27

Access interventions search

Searches were run between 11 and 17th June 2020 and re run on 9th April 2021 in the following databases: Medline, Medline in Process, Medline epubs ahead of print, Embase, Emcare and Psycinfo (all via the Ovid platform), CENTRAL and the Cochrane Database of Systematic Reviews (via the Wiley platform), Database of Abstracts of Reviews of Effects (DARE, via the Centre for Reviews and Dissemination platform), Applied Social Sciences Index and Abstracts (ASSIA), British Nursing Index, and Sociological Abstracts (all via the Proquest platform). The Medline version of the intervention terms are shown below. Population terms, the OECD geographic filter, RCT, systematic review and observational study design filters as described above were used.

1. exp Health Services Accessibility/
2. (access* or available or availability or convenien* or opportuni*).tw.
3. ((out or extended) adj2 hour*).tw.
4. (drop adj2 in).tw.
5. Community health centers/
6. ((community or public or civic or communal or municipal) adj4 (setting* or venue* or locat* or building* or facilit* or clinic* or hall* or centre* or center* or space*)).tw.
7. Pharmacies/
8. ((community or retail) adj4 pharmac*).tw.
9. Prenatal Care/ or Perinatal care/ or Maternal Child Health centers/
10. ((prenatal or antenatal or pregnan*) adj4 (care or service* or clinic*)).tw.
11. ((drug or alcohol or specialist or dedicated or "substance abuse") adj4 (service* or clinic* or care)).tw.
12. exp Community Mental Health Services/ or Substance Abuse Treatment Centers/
13. Libraries/
14. (library or libraries).tw.
15. ((child or children* or leisure or resource or day) adj4 (centre* or center*)).tw.
16. schools/ or schools, nursery/
17. (school* or nursery or nurseries or kindergarten* or "pre school*" or "play group*").tw.
18. (walk adj1 in adj4 (centre* or center* or clinic* or service*)).tw.
19. ((extend* or weekend or early or evening or commuter) adj4 (clinic* or service* or appointment* or session*)).tw.
20. ("24 hour* " or "twenty four hour*" or "all day" or "seven day" or "7 day").tw.
21. exp Home Care Services/
22. adult day care centers/ or exp child day care centers/ or Senior Centers/
23. ((home or domiciliary or day) adj4 (care or visit*)).tw.
24. Self-Help Groups/
25. ((support or self-help) adj4 (group* or meeting*)).tw.
26. Homes for the Aged/
27. exp Nursing Homes/
28. ((residential or nursing or care) adj4 home*).tw.
29. exp Education, Special/
30. (special adj4 (education or school*)).tw.
31. Inpatients/
32. inpatient*.tw.
33. Prisons/ or Prisoners/
34. (prison* or jail).tw.
35. (young adj4 (Offender* or detention)).tw.
36. (youth adj4 (detention or custody)).tw.
37. (juvenile adj4 (offender* or hall or detention)).tw.
38. (HMYOI* or YOI* or STC* or "secure training centre*").tw.
39. ((secure or correction* or detention) adj4 (accommodation or care or home or centre* or center* or facilit*)).tw.

40. exp "Emigrants and Immigrants"/
41. ((immigration or immigrant*) adj4 (removal or detention or detain* or accomodat* or hous* or home* or rent*)).tw.
42. 87 Mobile Health Units/
43. 88 ((mobile or outreach) adj4 (clinic* or unit* or service*)).tw.
44. 89 ("making every contact count" or MECC).tw.
45. 90 or/1-45

Education interventions search

Searches were run on 29th October 2020 and re run on 9th April 2021 in the following databases: Medline, Medline in Process, Medline epubs ahead of print, Embase, Emcare and Psycinfo (all via the Ovid platform), CENTRAL and the Cochrane Database of Systematic Reviews (via the Wiley platform), Database of Abstracts of Reviews of Effects (DARE, via the Centre for Reviews and Dissemination platform), Applied Social Sciences Index and Abstracts (ASSIA), British Nursing Index, Sociological Abstracts and ERIC (Educational Resources Information Center) (all via the Proquest platform). The Medline version of the intervention terms are shown below. Population terms, the OECD geographic filter and RCT study design filter as described above were used.

1. exp Communication/
2. ((Vaccin* or immuni*) adj4 (Communic* or messag* or listen* or negotiat* or persua* or dialogu* or conversation* or question* or discuss*)).tw.
3. ((universal or population or national* or public health or nationwide* or statewide* or countrywide* or citywide* or national* or nation wide* or state wide* or country wide* or city wide* or government*) adj4 (promotion* or campaign* or intervention* or toolkit* or strateg*)).tw.
4. (rais* adj2 awareness adj4 (promotion* or campaign* or intervention* or toolkit* or strateg*)).tw.
5. exp Consumer Health Information/
6. Social Media/
7. electronic mail/
8. Mobile Applications/
9. exp Internet/
10. exp Cell Phone/
11. exp Computers, Handheld/
12. Medical Informatics Applications/
13. Therapy, Computer-Assisted/
14. (app or apps).ti,ab.
15. (online or web or internet or digital*).ti.
16. ((online or web or internet or digital*) adj3 (based or application* or intervention* or program* or therap*)).ab.
17. (phone* or telephone* or smartphone* or cellphone* or smartwatch* or tablet*).ti.
18. ((phone* or telephone* or smartphone* or cellphone* or smartwatch or tablet*) adj3 (based or application* or intervention* or program* or therap*)).ab.
19. (mobile health or mhealth or m-health or ehealth or e-health or emental or e-mental).ti.
20. ((mobile health or mhealth or m-health or ehealth or e-health or emental or e-mental) adj3 (based or application* or intervention* or program* or therap*)).ab.
21. (mobile* adj3 (based or application* or intervention* or device* or technolog*)).ti,ab.
22. (twitter or tweet* or blog* or pinterest or instagram or facebook or snapchat).tw.
23. ((text or multimedia) adj messag*).tw.
24. (sms or whatsapp* or email* or "e-mail*" or "electronic mail*" or "e mail*").tw.
25. exp Mass Media/

26. (media or radio* or television* or tv* or broadcast* or podcast* or newspaper* or magazine* or display* or presentation*).tw.
27. Correspondence as Topic/
28. (correspond* or letter* or mail).tw.
29. Pamphlets/
30. (leaflet* or pamphlet* or booklet* or flyer* or brochure* or handout* or newsletter* or factsheet* or postcard* or banner* or bulletin*).tw.
31. ((print* or written*) adj4 (media or material*)).tw.
32. Health Promotion/
33. ((health or media) adj4 (campaign* or promot*)).tw.
34. Health Knowledge, Attitudes, Practice/
35. Advertising/
36. advert*.tw.
37. Posters as Topic/
38. poster*.tw.
39. Government Publications as Topic/
40. exp Education/
41. ((vaccin* or immuni*) adj4 (educ* or teach* or instruct* or learn* or "e-learn*" or " e learn*" or coach* or train* or aware* or inform*)).tw.
42. ((train* or development*) adj4 (inservice or staff or professional)).tw.
43. exp Interpersonal Relations/
44. Hospital Patient Relations/
45. Community Institutional Relations/
46. Community Networks/
47. ((communit* or social) adj4 network*).tw.
48. peer influence/
49. ((peer* or family or families or friend* or professional* or GP* or doctor* or physician* or nurse* or "health visitor*" or midwife or midwives or "social worker*" or leader* or community or communities or teacher* or faith) adj4 (influence* or pressure* or recommend* or advice or advise* or led or support* or educ* or advocat*)).tw.
50. Mentors/
51. (mentor* or "role model*").tw.
52. hotlines/
53. (champion* or hotline*).tw.
54. House calls/
55. ((house or home) adj4 (call* or visit*)).tw.
56. Self-Help Groups/
57. (group* adj2 (support* or self-help*)).tw.
58. exp Treatment Refusal/
59. Choice Behavior/
60. (decision* adj4 (making or support or aid*)).tw.
61. exp Informed Consent/
62. (informed adj4 (consent or choice* or decision*)).tw.
63. ((vaccin* or immuni*) adj4 (hesitan* or refus* or trust* or distrust* or accept* or confiden* or reject* or doubt* or decline*)).tw.

Infrastructure Interventions search

Searches were run on 28th September 2020 and re run on 12th April 2021 in the following databases: Medline, Medline in Process, Medline epubs ahead of print, Embase, Emcare ,Psycinfo and HMIC (Health Management and Policy Database) (all via the Ovid platform), CENTRAL and the Cochrane Database of Systematic Reviews (via the Wiley platform), Database of Abstracts of Reviews of Effects (DARE, via the Centre for Reviews and Dissemination platform), Applied Social Sciences Index and Abstracts (ASSIA), British Nursing Index, and Sociological Abstracts (all via the Proquest platform). The Medline

version of the intervention terms are shown below. Population terms, the OECD geographic filter and RCT study design filter as described above were used.

1. "Appointments and Schedules"/
2. (appointment* or schedul* or book* or rebook* or follow-up or follow up).tw.
3. "Organization and Administration"/
4. Health Planning/
5. "Delivery of Health Care"/og or "Delivery of Health Care"/st
6. Organizational Objectives/
7. Community Health Services/og or Community Health Services/st
8. ((service* or system* or team* or practice* or provider*) adj4 (administ* or organis* or organiz* or coordin* or co ordin* or co-ordin* or logistic* or plan* or structur*)).tw.
9. Statistics as Topic/
10. Data Collection/ or Datasets as Topic/ or Data Analysis/ or Data interpretation, Statistical/ or Data Management/ or Electronic Data Processing/
11. exp Clinical Audit/
12. Feedback/
13. (data* or audit* or statistic* or feedback or intelligence or dashboard* or analytics or analysis).tw.
14. Quality Indicators, Health Care/
15. Quality Improvement/og or Quality Improvement/st
16. Quality Assurance, Healthcare/og or Quality Assurance, Healthcare/st
17. (qof* or (quality adj4 (indicator* or outcome* or framework*))).tw.
18. "Facility Design and Construction"/
19. Built Environment/
20. Architecture/
21. ((building* or facilit* or premises or office* or room* or surger* or environment* or clinic or clinics or setting*) adj4 (design* or construct* or layout* or configur*)).tw.
22. "Treatment Adherence and Compliance"/ or Patient Compliance/
23. Motivation/
24. (incentive* or disincentive* or motivat*).tw.
25. Punishment/
26. (punish* or fine* or penal* or sanction* or deter* or discourage*).tw.
27. Reward/
28. (reward* or encourage* or attract* or reimburse* or pay or payment).tw.
29. Reimbursement, Incentive/ or Physician Incentive Plans/
30. Mandatory Programs/
31. (mandat* or compulsory or obligat*).tw.
32. infrastructure*.tw.

Acceptability Interventions Search

Searches were run on 4th and 5th February 2021 and re run on 12th April 2021 in the following databases: Medline, Medline in Process, Medline epubs ahead of print, Embase, Emcare and Psycinfo (all via the Ovid platform), CENTRAL and the Cochrane Database of Systematic Reviews (via the Wiley platform), Database of Abstracts of Reviews of Effects (DARE, via the Centre for Reviews and Dissemination platform), Applied Social Sciences Index and Abstracts (ASSIA), British Nursing Index, and Sociological Abstracts (all via the Proquest platform). The Medline version of the intervention terms are shown below. Population terms, the OECD geographic filter, RCT, systematic review and observational study design filters as described above were used

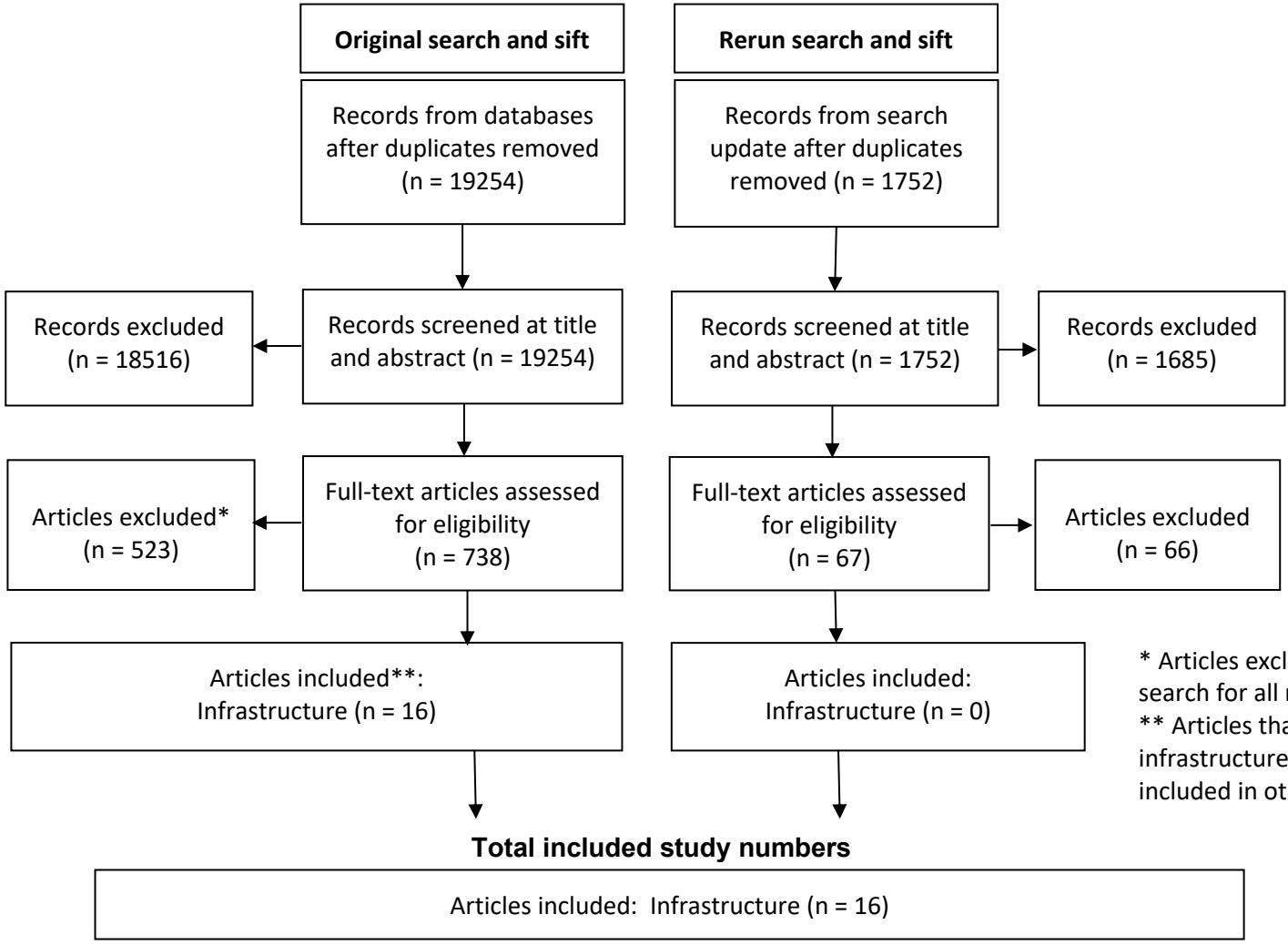
1. acceptab*.kw.
2. exp "Patient Acceptance of Health Care"/
3. exp Patient Satisfaction/
4. Choice Behavior/
5. (accept* or prefer* or option* or choice* or choose* or chose* or satisf* or tolera*).tw.
6. or/1-5
7. exp Drug Administration Routes/
8. ((subcutaneous* or cutaneous* or intravenous* or inhal* or nasal* or intranasal* or intramuscular* or topical* or oral* or infus* or intradermal*) adj4 (administ* or route* or appli* or dispens* or deliver* or method*)).tw.
9. (inject* or shot* or jab* or patch* or liquid* or drop* or spray* or needle* or syringe*).tw.
10. (dose* or dosage or formulation*).tw.
11. or/7-10
12. exp Physicians/
13. (doctor* or gp* or "general practitioner*" or physician*).tw.
14. exp Nurses/
15. (nurse* or midwife or midwives).tw.
16. Nursing Assistants/
17. ((nurse or nursing) adj2 (aide* or assistant*)).tw.
18. ((healthcare or "health care") adj2 assistant*).tw.
19. hca*.tw.
20. Pharmacists/ or Pharmacy Technicians/
21. (pharmacist* or (pharmacy adj2 technician*)).tw.
22. or/12-21
23. 11 or 22
24. (uptake or ((increas* or improv* or rais* or higher) adj8 (rate* or immuni* or vaccin* or complian*))).tw.
25. 23 and 24
26. 6 or 25

A single search to identify economic evidence for all review questions was run on 12th February 2020.The following databases were searched: Medline, Medline in Process, Embase, Econlit (all via the Ovid platform) NHS Economic Evaluation Database (NHS EED) and the Health Technology Assessment Database (HTA) (via the CRD platform). The searches were re run on 13th April 2021 with the HTA database replaced by the International Health Technology Database (INAHTA). The Medline strategy is presented below

1	1	Diphtheria/
2	2	diphtheria*.tw.
3	3	Tetanus/
4	4	(tetanus or tetani).tw.
5	5	Whooping Cough/
6	6	(pertuss* or "whooping cough").tw.
7	7	Haemophilus influenzae type b/
8	8	("Haemophilus influenza* type b" or "Hemophilus influenza* type b" or hib).tw.
9	9	Hepatitis B/
10	10	"hepatitis b".tw.
11	11	exp Poliomyelitis/
12	12	(Polio* or (infantile adj1 paralysis)).tw.
13	13	exp Pneumococcal Infections/
14	14	(Pneumococcal adj4 (disease* or infection*)).tw.
15	15	(streptococcus pneumoniae adj4 Infection*).tw. (
16	16	exp Meningococcal Infections/
17	17	(Meningococcal adj4 (disease* or infection*)).tw.
18	18	Rotavirus Infections/ or Rotavirus/
19	19	rotavirus.tw.
20	20	Measles/
21	21	(measles or rubeola or mmr).tw.
22	22	Mumps/
23	23	(mumps or (epidemic adj2 (parotitides or parotitis))).tw.
24	24	Rubella/ or Rubella virus/
25	25	(rubella or ((german or "three day") adj2 measle*)).tw.
26	26	human papillomavirus 16/ or human papillomavirus 18/ or exp papillomavirus Infections/ or exp human papillomavirus 11/
27	27	(hpv or papillomavirus).tw.
28	28	Condylomata Acuminata/
29	29	(condyloma* adj1 acuminat*).tw.
30	30	((genital or veneral) adj2 wart*).tw.
31	31	exp Herpes Zoster/
32	32	(shingles or herpes zoster or zona).tw.
33	33	or/1-32
34	34	exp Vaccination/
35	35	Vaccines/ or exp bacterial vaccines/ or cancer vaccines/ or exp toxoids/ or exp vaccines combined/ or exp viral vaccines/
36	36	exp Immunization programs/
37	37	vaccin*.tw.
38	38	exp Immunization/
39	39	(immunis* or immuniz*).tw.
40	40	(immunologic* adj4 (sensitiz* or sensitis* or stimulation*)).tw.
41	41	(immunostimul* or variolation*).tw.
42	42	or/34-41
43	43	33 and 42
44	44	exp Diphtheria toxoid/ or exp tetanus toxoid/ or Haemophilus Vaccines/ or meningococcal Vaccines/ or exp Pertussis Vaccine/ or exp Streptococcal vaccines/ or exp Vaccines Combined/ or exp Measles vaccine/ or exp Mumps Vaccine/ or exp papillomavirus vaccines/ or exp Poliovirus Vaccines/ or Rotavirus Vaccines/ or exp Rubella Vaccine/ or Hepatitis B vaccines/ or Herpes Zoster Vaccine/
45	45	43 or 44
46	46	animals/ not humans/
47	47	45 not 46
48	48	limit 47 to english language/
49	49	limit 48 to ed=19900101-20200212

50 afghanistan/ or exp africa/ or albania/ or andorra/ or antarctic regions/ or argentina/ or exp asia, central/ or exp asia, northern/ or exp asia, southeastern/ or exp atlantic islands/ or bahrain/ or bangladesh/ or Bhutan/ or bolivia/ or borneo/ or "bosnia and Herzegovina"/ or brazil/ or bulgaria/ or exp central america/ or exp china/ or colombia/ or "Commonwealth of Independent States"/ or croatia/ or "Democratic People's Republic of Korea"/ or ecuador/ or gibraltar/ or guyana/ or exp india/ or indonesia/ or iran/ or iraq/ or jordan/ or kosovo/ or kuwait/ or lebanon/ or liechtenstein/ or macau/ or "macedonia (republic)"/ or exp melanesia/ or moldova/ or monaco/ or mongolia/ or montenegro/ or nepal/ or Netherlands Antilles/ or New Guinea/ or oman/ or pakistan/ or paraguay/ or peru/ or philippines/ or qatar/ or "republic of Belarus"/ or romania/ or exp russia/ or saudi arabia/ or serbia/ or sri lanka/ or suriname/ or syria/ or taiwan/ or exp transcaucasia/ or ukraine/ or uruguay/ or united arab emirates/ or exp ussr/ or venezuela/ or yemen/ (1062747)
51 australasia/ or exp australia/ or austria/ or exp Baltic States/ or belgium/ or exp canada/ or chile/ or czech republic/ or europe/ or European Union/ or exp france/ or exp germany/ or greece/ or hungary/ or ireland/ or Israel/ or exp italy/ or exp japan/ or korea/ or luxembourg/ or mexico/ or netherlands/ or new zealand/ or north america/ or poland/ or portugal/ or exp "republic of korea"/ or exp "Scandinavian and Nordic Countries"/ or slovakia/ or slovenia/ or spain/ or switzerland/ or turkey/ or exp united kingdom/ or exp united states/ or "Organisation for Economic Co-Operation and Development"/ or Developed Countries/
52 50 not (50 and 51)
53 49 not 52 (53810)
54 Cost-Benefit Analysis/
55 Quality-Adjusted Life Years/
56 Markov Chains/
57 exp Models, Economic/
58 cost*.ti.
59 (cost* adj2 utilit*).tw.
60 (cost* adj2 (effective* or assess* or evaluat* or analys* or model* or benefit* or threshold* or quality or expens* or saving* or reduc*)).tw.
61 (economic* adj2 (evaluat* or assess* or analys* or model* or outcome* or benefit* or threshold* or expens* or saving* or reduc*)).tw.
62 (qualit* adj2 adjust* adj2 life*).tw.
63 QALY*.tw.
64 (incremental* adj2 cost*).tw.
65 ICER.tw.
66 utilities.tw.
67 markov*.tw.
68 (dollar* or USD or cents or pound or pounds or GBP or sterling* or pence or euro or euros or yen or JPY).tw.
69 ((utility or effective*) adj2 analys*).tw.
70 (willing* adj2 pay*).tw.
71 (EQ5D* or EQ-5D*).tw.
72 ((euroqol or euro-qol or euroquol or euro-quol or eurocol or euro-col) adj3 ("5" or five)).tw.
73 (european* adj2 quality adj3 ("5" or five)).tw.
74 or/54-73
75 53 and 74

Appendix C – Effectiveness evidence study selection



* Articles excluded as part of the combined quantitative search for all reviews
** Articles that were included specifically for the infrastructure review. The rest of the 215 articles were included in other reviews.

Appendix D – Effectiveness evidence tables

Birkhead, 1995

Bibliographic Reference	Birkhead, G.S.; LeBaron, C.W.; Parsons, P.; Grabau, J.C.; Barr-Gale, L.; Fuhrman, J.; Brooks, S.; Rosenthal, J.; Hadler, S.C.; Morse, D.L.; The immunization of children enrolled in the special supplemental food program for women, infants, and children (WIC): The impact of different strategies; Journal of the American Medical Association; 1995; vol. 274 (no. 4); 312-316

Study details

Study type	Cluster randomised controlled trial
Study location	USA
Study setting	Community
Study dates	1991
Sources of funding	Centers for Disease Control and Prevention
Inclusion criteria	A specific age group: Aged 12 to 59 months. A specified area: Families registered at 6 clinics in New York City. Participant matched inclusion criteria for vaccination: Measles vaccination.
Exclusion criteria	None
Intervention(s)	In accordance with policy, at all study sites the parents and guardians of children eligible for measles immunisation were taught about the complications of measles disease and the importance of measles immunisation. Educational materials were provided in English and Spanish on measles and on immunizations in general. Staff also stressed the importance of immunisations with parents in required group educational sessions. The names and telephone numbers of local health care providers where immunisations could be obtained were given to all eligible clients. **Intervention 1:** Escort: Children were accompanied by staff to the paediatric clinic in the same facility for express lane immunisation. Parents were told that vouchers would be available immediately on return from the escort. If there were a temporary contraindication to immunization (for example, high fever), parents were told to return when the child was well enough to be escorted. Staff continued to offer escort at subsequent visits to children who were not successfully escorted at study enrolment. Food vouchers were dispersed according to the normal schedule whether families accepted or declined escort. **Intervention 2:** Voucher Incentive: The family returned on a monthly, rather than the normal every-2-months schedule, to pick up food vouchers until the child was immunised. No clients were ever denied at least a 1-month supply of food vouchers.
Comparator	Referral: The vaccination assessment, education, and referral services mandated by policy were provided, but no additional interventions were offered. No further information on reminders was provided. In accordance with policy, at all study sites the parents and guardians of children eligible for measles immunisation were taught about the complications of measles disease and the importance of measles immunisation. Educational materials were provided in English and Spanish on measles and on immunizations in general. Staff also stressed the importance of immunisations with parents in required group

	educational sessions. The names and telephone numbers of local health care providers where immunisations could be obtained were given to all eligible clients.
Outcome measures	Vaccine uptake
Number of participants	836
Duration of follow-up	8 months
Loss to follow-up	None
Additional comments	This study took place just after a large measles outbreak from 1990 to 1991 at New York City. There was no ICC provided in this study or in another similar study. Therefore, we adjusted the data for clustering using an ICC of 0.05, which was the most common ICC in the education and reminders evidence review. This study features in the access, reminders, and infrastructure evidence reviews.

1 **Study arms**

Child was escorted to a nearby paediatric clinic for immunisation + vouchers (N = 377)
Family was offered vouchers for monthly visits until child was immunised (N = 178)
Family was referred for immunisation (N = 281)

2 **Characteristics**

3 **Arm-level characteristics**

	Child was escorted to a nearby paediatric clinic for immunisation + vouchers (N = 377)	**Family was offered vouchers for monthly visits until child was immunised (N = 178)**	**Family was referred for immunisation (N = 281)**
Mother's median age *(years)*			
Nominal	26	26	29

4

Section	**Question**	**Answer**
1a. Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Although no details were provided about the randomisation process, the baseline characteristics were fairly equal for all 3 arms considering that it was a randomisation of 6 clinics.)*
1b. Bias arising from the timing of identification and recruitment of individual participants in relation to timing of randomisation	Risk of bias judgement for the timing of identification and recruitment of individual participants in relation to timing of randomisation	Low

Section	Question	Answer
2. Bias due to deviations from intended interventions (If your aim is to assess the effect of assignment to intervention, answer the following questions).	Risk of bias judgement for deviations from intended interventions	Low
3. Bias due to missing outcome data	Risk of bias judgement for missing outcome data	Low
4. Bias in measurement of the outcome	Risk of bias judgement for measurement of the outcome	Some concerns *(It is possible that lack of blinding and effort required to collect data could have biased the results in the arms in an uneven way.)*
5. Bias in selection of the reported result	Risk of bias for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	Some concerns *(Some concerns with data collection.)*
	Overall Directness	Partially applicable *(This study began within weeks or months of a major measles outbreak ending in New York City. This is not a normal situation for routine vaccines and it could have influenced uptake.)*

1

Caskey, 2017

2

Bibliographic Reference	Caskey, Rachel; Sherman, E Grace; Beskin, Kera; Rapport, Rebecca; Xia, Yinglin; Schwartz, Alan; A Behavioral Economic Approach to Improving Human Papillomavirus Vaccination.; The Journal of adolescent health : official publication of the Society for Adolescent Medicine; 2017; vol. 61 (no. 6); 755-760

3 **Study details**

Study type	Non-randomised controlled trial
Study location	USA
Study setting	A general paediatric clinic at a large academic medical centre.
Study dates	2013 to 2014
Inclusion criteria	Individuals with a specified age (range): Adolescents 11-17-years of age
Exclusion criteria	Had previously been vaccinated with the vaccine(s) being studied Individuals that did not speak English
Intervention(s)	At the time of enrolment, parents in the intervention group were given a virtual personal deposit account with the following terms: at the time the first dose of HPV vaccine is received, $25 was deposited into the account; at the time the second dose of HPV vaccine is received, another $25 was deposited into the account; and upon receipt of the third dose, the participant was given $50 in cash. Participants received a tangible document, resembling a bank account statement, showing the deposit after each dose of the vaccine. During the consent process, the participants were told that HPV vaccine three-dose completion had to be within 12 months of their enrolment date into the study, and all doses of the HPV vaccine had to be administered at the clinic where the study enrolment occurred. If a participant did not complete the three dose series within a 12-month period, all accrued funds were forfeited. All HPV vaccines on the market

	are a series of three doses over a 6-month period. The time frame for series dose completion for this study was a year to provide flexibility because each dose required a visit to the clinic. If an intervention group participant missed a scheduled clinic visit that could have resulted in an HPV vaccination, based on the time since the last dose, the participant was mailed a letter. Rather than reminding the participants how much they would receive if they completed the study (a typical research study reminder letter), the letters served to leverage loss aversion by reminding the participants how much money they would lose if HPV vaccination was not completed within the 12-month period.
Comparator	Usual care
Outcome measures	Vaccine uptake
Number of participants	188
Duration of follow-up	12 months

Study arms

Escalating delayed cash incentive (N = 85)
Control (N = 103)

Characteristics

Arm-level characteristics

	Escalating delayed cash incentive (N = 85)	**Control (N = 103)**
% Female *(%)*		
Nominal	51.8	48.5

Section	**Question**	**Answer**
1. Bias due to confounding	Risk of bias judgement for confounding	Low
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low
5. Bias due to missing data	Risk of bias judgement for missing data	Low
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Moderate *(No information provided on how data was collected. Blinding of assessors was not mentioned.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low
Overall bias	Risk of bias judgement	Serious *(Issues with outcome measurement and this was a*

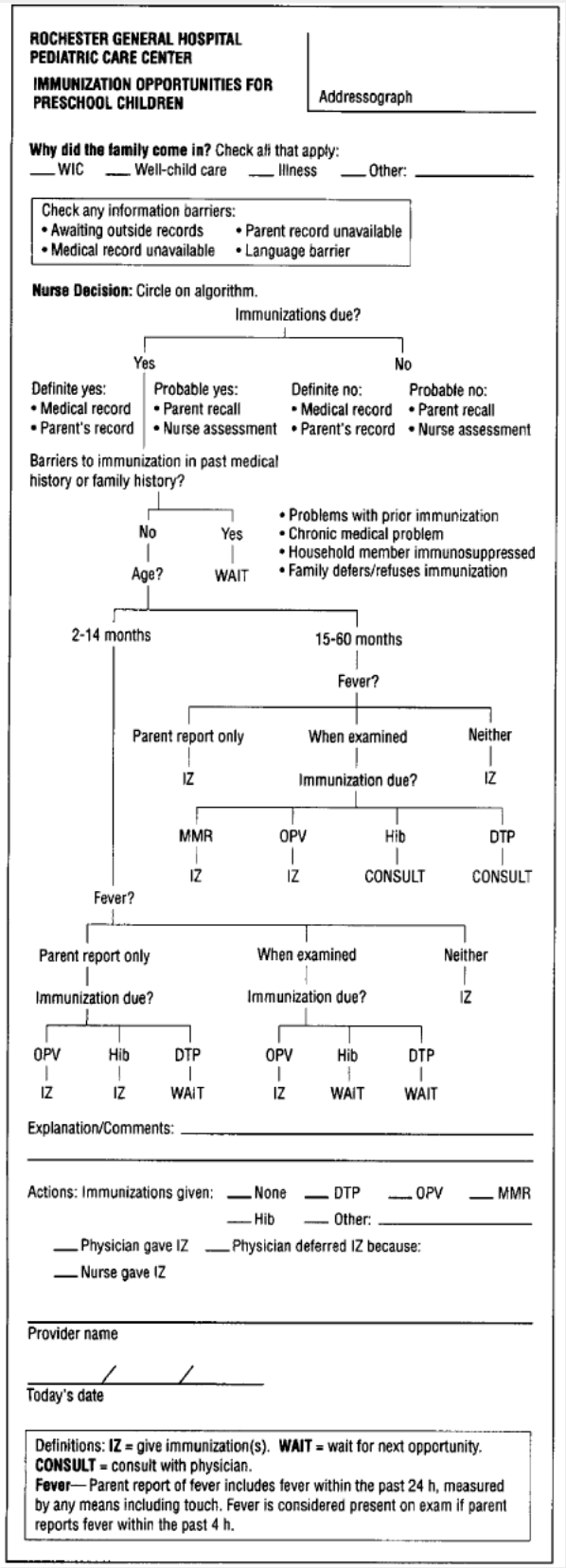
Section	Question	Answer
		quasi-randomised study because participants were selected for each arm depending on the day of the week they attended the clinic.)
	Directness	Directly applicable

Christy, 1997

Bibliographic Reference	Christy, C; McConnochie, K M; Zernik, N; Brzoza, S; Impact of an algorithm-guided nurse intervention on the use of immunization opportunities.; Archives of pediatrics & adolescent medicine; 1997; vol. 151 (no. 4); 384-91

Study details

Study type	Retrospective cohort study
Study location	USA
Study setting	Hospital-based paediatric primary care centres
Study dates	1990 to 1991
Sources of funding	Not mentioned
Inclusion criteria	Individuals with a specified age (range): Age 2 to 60 months. Participants were active patients and made 1 or more study visits. Active patients included patients who either made visits within the first 4 months of life or made visits that spanned at least 6 months. The latter criterion was included to allow sufficient time to obtain the records of children who had previously received immunizations at other sites. Study visits included those that (1) occurred within a study period, (2) were made by active patients, (3) were not for well-childcare, and (4) occurred during daytime nursing shifts when the intervention was used. These criteria focused the study on visits for non-well-childcare visits (i.e. visits for acute or chronic illness, for follow-up of acute illness, or for certification for the Supplemented Feeding Progam for Women, Infants, and Children), at which preschool immunisations might be given.
Exclusion criteria	None
Intervention(s)	A nursing intervention was guided by an algorithm form that was developed in collaboration with the PCC nursing staff. A picture of the algorithm is shown here:



ROCHESTER GENERAL HOSPITAL
PEDIATRIC CARE CENTER

IMMUNIZATION OPPORTUNITIES FOR PRESCHOOL CHILDREN

Addressograph

Why did the family come in? Check all that apply:
___ WIC ___ Well-child care ___ Illness ___ Other: _____

Check any information barriers:
- Awaiting outside records
- Medical record unavailable
- Parent record unavailable
- Language barrier

Nurse Decision: Circle on algorithm.

Immunizations due?

Yes

Definite yes:	Probable yes:
• Medical record • Parent's record	• Parent recall • Nurse assessment

No

Definite no:	Probable no:
• Medical record • Parent's record	• Parent recall • Nurse assessment

Barriers to immunization in past medical history or family history?

No → Age?

Yes → WAIT

- Problems with prior immunization
- Chronic medical problem
- Household member immunosuppressed
- Family defers/refuses immunization

Age?

2-14 months

Fever?

- Parent report only → IZ
- When examined → Immunization due?
  - MMR → IZ
  - OPV → IZ
  - Hib → CONSULT
  - DTP → CONSULT
- Neither → IZ

15-60 months

Fever?

- Parent report only → Immunization due?
  - OPV → IZ
  - Hib → IZ
  - DTP → WAIT
- When examined → Immunization due?
  - OPV → IZ
  - Hib → WAIT
  - DTP → WAIT
- Neither → IZ

Explanation/Comments: _____

Actions: Immunizations given: ___ None ___ DTP ___ OPV ___ MMR
___ Hib ___ Other: _____

___ Physician gave IZ ___ Physician deferred IZ because:

___ Nurse gave IZ

_____
Provider name

_____
Today's date

Definitions: **IZ** = give immunization(s). **WAIT** = wait for next opportunity. **CONSULT** = consult with physician.
Fever— Parent report of fever includes fever within the past 24 h, measured by any means including touch. Fever is considered present on exam if parent reports fever within the past 4 h.

WIC = supplemented feeding programme for Women Infants and Children. OPV = live oral poliovirus vaccine.

The use of the form to record immunization decisions was strongly encouraged, but it varied considerably among nurses and with the level of service demands.
If nurses determined that an immunization was due, the presence of contraindications was assessed. This decision was based on a history of problems

	with prior immunisation, chronic medical problems, or the presence of an immunosuppressed family member. Immunizations were deferred if the family decided to wait until the next immunization opportunity at a well-childcare appointment. The decision to immunize in the presence of fever varied between the ages of 2 and 14 months and 15 and 60 months. Recommendations for immunizing in the presence of fever were based on the 1991 Red Book that states, "minor illnesses with or without fever do not contraindicate the use of live virus vaccines such as MMR," and "mild illnesses (e.g., upper respiratory tract illnesses) do not contraindicate administration of DTP or other vaccines." In the absence of explicit operational guidelines from recognized authorities, we chose conservatively to use the presence of fever (temperature, >38°C measured by any method) as the indicator of an illness of greater than mild severity. This decision was reflected on the algorithm. Fevers included those that were reported by the parent within 4 hours prior to the visit or as measured in the PCC.
Comparator	Usual care
Outcome measures	Vaccine uptake
Number of participants	2101
Duration of follow-up	Not applicable - this was a retrospective cohort study.
Additional comments	No relevant baseline characteristics were provided. Data for a retrospective control arm was also included. This was excluded from the analysis because it should be more prone to bias compared to the concurrent control arm that was also included in the study. Data for DTP, polio, MMR and Hib vaccine uptake were provided separately.

Study arms

Algorithm for nurses during non-well child care visits (N = 875)
Control (N = 1226)

Characteristics

Arm-level characteristics

	Algorithm for nurses during non-well child care visits (N = 875)	**Control (N = 1226)**
median age *(Months)*		
Nominal	28.3	28.4

Section	**Question**	**Answer**
1. Bias due to confounding	Risk of bias judgement for confounding	Low
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low

Section	Question	Answer
5. Bias due to missing data	Risk of bias judgement for missing data	Low
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Low
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Moderate *(There was no information provided as to how data was collected.)*
Overall bias	Risk of bias judgement	Serious *(No information as to how data was collected. This was a retrospective cohort study.)*
	Directness	Directly applicable

Fairbrother, 2001

Bibliographic Reference	Fairbrother G; Siegel MJ; Friedman S; Kory PD; Butts GC; Impact of financial incentives on documented immunization rates in the inner city: results of a randomized controlled trial.; Ambulatory pediatrics : the official journal of the Ambulatory Pediatric Association; 2001; vol. 1 (no. 4)

Study details

Study type	Cluster randomised controlled trial
Study location	USA
Study setting	Family practices and paediatric clinics
Study dates	1997 to 1998
Sources of funding	Centers for Disease Control and Prevention
Inclusion criteria	Individuals with a specified age (range): 3 to 35 months of age The medical records showed a visit within the year before the medical record review, and the medical records showed no note of the child moving or leaving the practice.
Exclusion criteria	None
Intervention(s)	**Intervention 1:** Physicians assigned to the bonus with feedback group received at each data collection point $1000 and $2500 for 30% and 45% improvements at the end of the first 4 months, respectively; $5000 for reaching 80% up to date coverage irrespective of performance level after 4 months; and $7500 for reaching 90% up to date coverage. Amounts were chosen to reward improvement and achievement and to be sizable enough to encourage behaviour change. **Intervention 2:** Physicians assigned to the EFF group received $5 for each vaccine that they administered within 30 days of its coming due and $15 for each visit at which all due vaccines were administered. Physicians in the 2 intervention groups received feedback on their immunization performance at the time of data collection and in more detail in a letter mailed to each physician approximately 16 days later along with any applicable financial award. This feedback letter included narrative and easy-to- read charts showing UTD coverage rates for diphtheria and tetanus toxoids and pertussis vaccine (DTP), Haemophilus influenzae type b vaccine (Hib), polio vaccine, and MMR. An honorarium fee of $100 was given to all physicians during the last round of data collection to compensate for time spent in an interview.

Comparator	The control group received feedback on their performance with respect to lead and anaemia screenings. The feedback included overall UTD screening rates, rates by patient age groups, and comparisons with peer performance. Physicians in the control group received an honorarium of $300 for allowing the investigators to review their charts. An honorarium fee of $100 was given to all physicians during the last round of data collection to compensate for time spent in an interview.
Outcome measures	Vaccine uptake
Number of participants	2815
Duration of follow-up	16 months
Loss to follow-up	None
Additional comments	Up to date vaccination status was assessed for: DTaP, Hib B, polio, and MMR. The data used for the review was for the latest timepoint at 16 months. This should allow more time for the interventions to be bedded in. With the exception of baseline uptake, the baseline characteristics for each separate arm were not provided. No ICC was provided but uptake percentages were adjusted for clustering by the investigators. The numbers of participants for each arm was not provided. Therefore, for the meta-analysis we estimated the number of participants for each arm to be: 2815/3 ≈ 938

Study arms

Bonus and feedback (N = 938)
Enhanced fee for service and feedback (N = 938)
Control (N = 938)

Characteristics

Arm-level characteristics

	Bonus and feedback (N = 938)	**Enhanced fee for service and feedback (N = 938)**	**Control (N = 938)**
Baseline vaccine uptake *(%)*			
Nominal	49.7	50.8	45.3

Section	**Question**	**Answer**
1a. Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low
2. Bias due to deviations from intended interventions (If your aim is to assess the effect of assignment to intervention, answer the following questions).	Risk of bias judgement for deviations from intended interventions	Low
3. Bias due to missing outcome data	Risk of bias judgement for missing outcome data	Low
4. Bias in measurement of the outcome	Risk of bias judgement for measurement of the outcome	Some concerns *(There was no information with*

Section	Question	Answer
		regards to how data was collected.)
5. Bias in selection of the reported result	Risk of bias for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	High *(Some concerns with not providing data on numbers of participants in each arm and with data collection.)*
	Overall Directness	Directly applicable

1

Fairbrother, 1999

2

Bibliographic Reference	Fairbrother, G; Hanson, K L; Friedman, S; Butts, G C; The impact of physician bonuses, enhanced fees, and feedback on childhood immunization coverage rates.; American journal of public health; 1999; vol. 89 (no. 2); 171-5

3

4 **Study details**

Study type	Cluster randomised controlled trial
Study location	USA
Study setting	Family practices and paediatric clinics
Study dates	1995 to 1996
Sources of funding	Not provided
Inclusion criteria	Individuals with a specified age (range): 3 to 35 months of age
Exclusion criteria	None
Intervention(s)	Physicians in each of the 3 intervention groups received feedback on their immunization performance at the time of data collection and, in more detail, in a letter mailed to each physician approximately 4 weeks later (mean = 3.9 weeks, SD = 2.9) along with any applicable financial award. This feedback included up-to-date coverage rates for immunizations, coverage by patient age groups, missed opportunities to immunize, comparisons with peers' performance, and hypothetical coverage rates calculated as if no opportunities had been missed and/or one more timely visit had been scheduled for vaccines due. **Intervention 1:** Bonus and feedback. Physicians assigned to the bonus and feedback group were eligible to receive financial bonuses based on patients' up-to-date coverage for DTP and Haemophilus influenzae type b (Hib), OPV, and MMR. Bonuses were awarded for improvement as well as achievement: $1000 for a 20% improvement from baseline, $2500 for a 40% improvement from baseline, and $5000 for reaching 80% coverage irrespective of baseline performance level. **Intervention 2:** Enhanced fee for service and feedback. Physicians assigned to the enhanced fee for service and feedback group received $5 for each vaccine they administered within 30 days of its coming due. A fee of $15 was awarded for each visit at which more than 1 vaccine was due, and all due vaccines were administered. **Intervention 3:** Feedback only, which has been described above.
Comparator	Physicians in the control group received feedback on their performance with respect to blood lead and tuberculosis screenings, as well as the monitoring of anaemia. This feedback included overall up-to-date screening rates, rates by patient age groups, and comparisons with peers' performance. (No feedback with regards to vaccines was provided.)

Outcome measures	Vaccine uptake
Number of participants	3019
Duration of follow-up	12 months
Loss to follow-up	None
Additional comments	• Up to date vaccination status was assessed for: DTP, Hib, polio, and MMR. • The data used for the review was for the latest timepoint at 12 months. This should allow more time for the interventions to be bedded in. • With the exception of baseline uptake, the baseline characteristics for each separate arm were not provided. • Uptake percentages were adjusted for clustering by the investigators. • The numbers of participants for each arm was not provided. Therefore, for the meta-analysis we estimated the number of participants for each arm to be: 3019/4 ≈ 755. This is an assumption that could bias the results, so results have been downgraded once for risk of bias. • Comparisons that had data from the arm 'enhanced fee for service and feedback' were downgraded an additional time to high risk of bias because this arm had a higher number of baseline vaccinated participants compared to other groups.

Study arms

Bonus and feedback (N = not reported)
Although the number of participants and clusters were not provided for each arm, the percentage uptake was adjusted for clustering by the investigators.

Enhanced fee for service and feedback (N = not reported)
Although the number of participants and clusters were not provided for each arm, the percentage uptake was adjusted for clustering by the investigators.

Feedback only (N = not reported)
Although the number of participants and clusters were not provided for each arm, the percentage uptake was adjusted for clustering by the investigators.

Control (N = not reported)
Although the number of participants and clusters were not provided for each arm, the percentage uptake was adjusted for clustering by the investigators.

Characteristics

Arm-level characteristics

	Bonus and feedback (N = not reported**)**	**Enhanced fee for service and feedback (N =** not reported**)**	**Feedback only (N =** not reported**)**	**Control (N =** not reported**)**
Baseline up-to-date vaccination coverage *(%)*				
Nominal	29.1	46.2	31.4	34.6

Section	**Question**	**Answer**
1a. Bias arising from the randomisation process	Risk of bias judgement for the	Some concerns *(Pre-study baseline vaccine uptake for the*

Section	Question	Answer
	randomisation process	*enhanced fee for service arm was higher compared to the other 3 arms (46.2% compared to a range of 29.1% to 34.6%). Therefore, there are some concerns for that arm's data.)*
2. Bias due to deviations from intended interventions (If your aim is to assess the effect of assignment to intervention, answer the following questions).	Risk of bias judgement for deviations from intended interventions	Low
3. Bias due to missing outcome data	Risk of bias judgement for missing outcome data	Low
4. Bias in measurement of the outcome	Risk of bias judgement for measurement of the outcome	Low *(Although there was no blinding at data collection, the investigators assessed this as a source of bias by comparing an unblinded sample of 303 to a blinded collection of the same data. They collected the same results.)*
5. Bias in selection of the reported result	Risk of bias for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	Some concerns *(Some concerns with not providing data on numbers of participants in each arm. Comparisons with data from the enhanced fee for service and feedback group was downgraded to high risk of bias due to problems with randomisation.)*
	Overall Directness	Directly applicable

1

Gavagan, 2010

2

Bibliographic Reference	Gavagan TF; Du H; Saver BG; Adams GJ; Graham DM; McCray R; Goodrick GK; Effect of financial incentives on improvement in medical quality indicators for primary care.; Journal of the American Board of Family Medicine : JABFM; 2010; vol. 23 (no. 5)

3 **Study details**

Study type	Prospective cohort study
Study location	USA
Study setting	Community health centres
Study dates	2001 to 2004
Sources of funding	There was no funding
Inclusion criteria	Individuals with a specified age (range): The 2002 USA vaccination schedule included children aged from birth to 18 years. Children attending 11 public community health centres in Houston/Harris County.

Exclusion criteria	None
Intervention(s)	A medical school, which had been using financial incentives based on individual physician visit and relative value unit productivity in the clinics it staffed, added performance on 3 quality indicators in preventive care to the incentive formula. One third of the available incentive pool was awarded for each of the following: quality indicators, relative value unit productivity, and visit volume performance. One third of the total incentive allocation was based on quality indicator performance. The financial incentive was paid to eligible members of the group if the clinic as a whole met or exceeded the thresholds for 2 of 3 indicators: Papanicolaou smears, mammography, and childhood immunizations. The thresholds, usually 80% to 90%, were determined by the hospital district Performance Improvement Committee and were changed each year based on previous performance. The potential $4000 annual pay-out based on achieving quality targets represented approximately 3% to 4% of a provider's total salary. If the clinic reached 2 out of 3 targets, all physicians in the clinic received the incentive to encourage teamwork. All physicians were aware of the incentive program because results were reviewed regularly during monthly staff meetings. The incentivized indicators intentionally were not emphasized more in the quality program than other non-incentivized indicators (prostate screening, cholesterol, adult immunization, tuberculosis screening, and diabetic foot, eye, and glycated haemoglobin) to avoid selective performance of those incentivised indicators. The maximum potential incentive per physician was $12,000 annually, representing $4000 each for quality, relative value unit productivity, and visit productivity.
Comparator	No financial incentive for childhood immunisations (and for Papanicolaou smears and mammography). Feedback on performance was the same for both arms.
Outcome measures	Vaccine uptake
Number of participants	544
Duration of follow-up	Data was collected quarterly for each year's quarter of data.
Loss to follow-up	None
Additional comments	Baseline characteristics were not provided. In the study, data was presented for each quarter for 4 years. However, we could not sum this data because children require different vaccinations at different time-points so there would have been double-counting of children. Therefore, we used the data for the last quarter of the final year because this was the last data collection point and processes were most likely to be embedded at this time-point. The data was for "paediatric immunisations" - specific ages were not provided and neither were the names of the specific vaccines. The recommended childhood immunisation schedule for the USA in 2002 included children aged from birth to 18 years. It included many vaccines relevant to the UK vaccination schedule (HepB, DTP, Hib, polio, MMR, and pneumococcal) and a few that the UK vaccination schedule does not have, such as HepA and varicella. Also, influenza vaccine is not included in this guideline: https://www.aafp.org/afp/2002/0101/p127.html

1 **Study arms**

Financial incentives for physicians (N = 6040)
Control (N = 2542)

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Serious *(Baseline characteristics were not provided so it is not possible to assess whether the cohorts were balanced.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low
5. Bias due to missing data	Risk of bias judgement for missing data	Low
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Low
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low
Overall bias	Risk of bias judgement	Serious *(It is not possible to assess whether the arms were balanced.)*
	Directness	Directly Applicable

Gilkey, 2019

Bibliographic Reference	Gilkey, M.B.; Parks, M.J.; Margolis, M.A.; McRee, A.-L.; Terk, J.V.; Implementing evidence-based strategies to improve HPV vaccine delivery; Pediatrics; 2019; vol. 144 (no. 1); e20182500

Study details

Study type	Cluster randomised controlled trial
Study location	USA
Study setting	Clinics in Cook Children's Health Care System
Study dates	2017
Sources of funding	None
Inclusion criteria	Individuals with a specified age (range): Adolescents aged 12 to 14 years. Physicians: Physicians who practiced in ambulatory care clinics serving primarily commercially insured patients and served panels of $50 patients aged 12 to 14, as identified by Cook Children's EMRs.
Exclusion criteria	Physicians who practiced in clinics in which they did not have defined patient panels. Physicians who worked in the clinic that piloted the QI program.
Intervention(s)	Quality improvement programme included a 1 hour in-clinic training session for physicians led by a high performing paediatrician (delivered >1 dose of the HPV

	vaccine to >70% of their 12- to 14-year-old patients). Training focused on the epidemiology of HPV, the need to improve HPV vaccine coverage, the vaccine's safety profile and prevention benefits, and the importance of delivering high-quality presumptive recommendations for HPV vaccination. The training also promoted communication strategies for cases where parents were hesitant about the vaccine. Training also included assessments for each physician which reported the percentage of 12- to 14- year-old patients in their panel who had initiated HPV vaccination. This was used to set a goal to raise HPV vaccination coverage over the 6-month project period by vaccinating at least 10% of their 12-to 14-year-old patients who had not initiated HPV vaccination.
Comparator	Waiting list control arm with no additional physician training.
Outcome measures	Vaccine uptake at 6 months
Number of participants	22983
Duration of follow-up	6 months
Loss to follow-up	1 Physician was lost to follow-up in the intervention arm out of an original total of 43. No physicians were lost to follow-up in the control arm – there were 35 of these.
Additional comments	Vaccine uptake data was for HPV, 1 dose or more. There was no ICC provided in this study or in another similar study. We adjusted the data for clustering using an ICC of 0.05, which was the most common ICC in the education and reminders evidence review.

Study arms

Face-to-face education with a high performing clinician with assessment and feedback (N = 11482) 13 clusters
Control (N = 11501) 12 clusters

Characteristics

Arm-level characteristics

	Face-to-face education with a high performing clinician with assessment and feedback (N = 11482)	**Control (N = 11501)**
Baseline HPV vaccination coverage *(%)*		
Nominal	52.6	44.6

Section	**Question**	**Answer**
1a. Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	High *(States that study is randomised but no further information. Some concerns over randomisation as the intervention arm had a higher baseline HPV coverage rate than the control arm)*
2. Bias due to deviations from intended interventions (If your aim is to assess the effect of assignment to intervention, answer the following questions).	Risk of bias judgement for deviations from intended interventions	Low

Section	Question	Answer
3. Bias due to missing outcome data	Risk of bias judgement for missing outcome data	Low
4. Bias in measurement of the outcome	Risk of bias judgement for measurement of the outcome	Low *(Outcome assessors may have been aware of intervention received but data was collected using their health service's integrated electronic medical record system.)*
5. Bias in selection of the reported result	Risk of bias for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	Some concerns *(States that study is randomised but no further information. Some concerns over randomisation as the intervention arm had a higher baseline HPV coverage rate than the control arm.)*
	Overall Directness	Directly applicable

Gilkey, 2014

Bibliographic Reference	Gilkey, MB; Dayton, AM; Moss, JL; Sparks, AC; Grimshaw, AH; Bowling, JM; Brewer, NT; Increasing provision of adolescent vaccines in primary care: a randomized controlled trial; Pediatrics; 2014; vol. 134 (no. 2); e346-53

Study details

Trial registration number and/or trial name	NCT01544764 AFIX (Assessment, Feedback, Incentives, and eXchange) immunisation programme
Study type	Cluster randomised controlled trial
Study location	USA
Study setting	Health care facilities in North Carolina's publicly funded vaccine programme
Study dates	2011
Sources of funding	Centers for Disease Control and Prevention
Inclusion criteria	Healthcare clinics: Paediatric and family practice clinics with more than 200 patients aged 11 to 18 years with active records in the registry.
Exclusion criteria	None
Intervention(s)	**Intervention 1:** Centre received an in-person consultation for the Centers for Disease Control and Prevention's AFIX (Assessment, Feedback, Incentives, and eXchange) immunisation programme (April 2011 - May 2011). AFIX involves an immunisation specialist who evaluates a clinic's vaccine coverage levels and works with providers to set goals for improvement. During the consultation, which consisted of a single 60- to 90-minute session, an immunization specialist met with the clinic's designated vaccine coordinator to evaluate vaccine coverage. In the "assessment and feedback" component, the immunization specialist presented coordinators with separate coverage estimates, specific to their clinic, for Tdap, meningococcal conjugate, 1 and 3 doses of HPV vaccine, 2 doses of measles-

	mumps-rubella (MMR), 3 doses of hepatitis B virus (HBV) and 2 doses of varicella. In the "exchange" component, the specialist helped coordinators gauge their progress by sharing information about average vaccine coverage for their clinic's county as well as coverage attained by other clinics within the county. In the "incentives" component, the specialist provided training in immunization best practices, such as how to maintain records in the immunization registry, how to generate reminders for patients, and how to decrease missed opportunities for concomitant vaccination. The vaccine coordinator selected several goals from a list of 20 prespecified immunization best practices on which to focus improvement efforts. At the 5-month follow-up, the specialist presented coordinators with updated vaccine coverage estimates so that they could assess their progress. **Intervention 2:** AFIX consultation delivered by webinar (May 2011-August 2011). Webinars used the same content and one-on-one approach as in-person consultations but were delivered using an interactive conferencing system.
Comparator	No AFIX vaccine programme was delivered.
Outcome measures	Vaccine uptake
Number of participants	91 clinics, 71628 adolescents
Duration of follow-up	1 year
Loss to follow-up	None
Additional comments	Gilkey 2014 does not say how many participants were in each arm. Because participants were randomised, it is probable that roughly 10,892 participants were in each arm for the 11-12 years age group and roughly 24,922 participants were in the 13-18 years age catch-up group. There was no ICC provided in this study or in another similar study. We adjusted the data for clustering using an ICC of 0.05, which was the most common ICC in the education and reminders evidence review. The data for HPV and MenACWY vaccines were included in the analysis. However, the data for pertussis, MMR, Tdap, HepB and varicella vaccines were excluded because they are not on the routine vaccination schedule for 11-18 years olds in the UK. The data for ≥1 HPV dose was included over the data for 3 doses of HPV because the former includes the data from the latter and some immunity is conferred by 1 dose. Data for the latest follow-up time point (1 year) was used in the analysis because this data is summative.

Study arms

In person vaccine programme (N = 0)
30 clusters. The number of participants in each arm was not provided.

Webinar-based vaccine programme (N = 0)
31 clusters. The number of participants in each arm was not provided.

Control (N = 0)
30 clusters. The number of participants in each arm was not provided.

Characteristics

Arm-level characteristics

	In person vaccine programme (N = 0)	Webinar-based vaccine programme (N = 0)	Control (N = 0)
% Female *(%)*			

	In person vaccine programme (N = 0)	Webinar-based vaccine programme (N = 0)	Control (N = 0)
Nominal	46	47	48

1
2
3

Section	Question	Answer
1a. Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Although the method of randomisation was not provided, the baseline characteristics of the participants seem balanced for each arm)*
2. Bias due to deviations from intended interventions (If your aim is to assess the effect of assignment to intervention, answer the following questions).	Risk of bias judgement for deviations from intended interventions	Low
3. Bias due to missing outcome data	Risk of bias judgement for missing outcome data	Low
4. Bias in measurement of the outcome	Risk of bias judgement for measurement of the outcome	Low *(Outcome assessors may have been aware of the intervention received, however, a central online tracking system was used to record uptake.)*
5. Bias in selection of the reported result	Risk of bias for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	High *(The number of participants in each arm was an estimate.)*
	Overall Directness	Directly applicable

4

Gill, 2002

5

Bibliographic Reference	Gill JM; Saldarriaga A; Mainous AG; Unger D; Does continuity between prenatal and well-child care improve childhood immunizations?; Family medicine; 2002; vol. 34 (no. 4)

6 **Study details**

Study type	Retrospective cohort study
Study location	USA
Study setting	Primary care clinics
Study dates	1997 to 1999
Sources of funding	Delaware Foundation for Medical Services and the DuPont Company.
Inclusion criteria	Individuals with a specified age (range): Immunisation status of child at 1 year old. Mothers were a specified age: 18 years old or over.
Exclusion criteria	None
Intervention(s)	**Intervention 1:** Provider continuity: The same provider and clinic for prenatal and well-childcare.

	Intervention 2: Clinic continuity: Having the same clinic but a different provider for prenatal and well-childcare. No other information was provided.
Comparator	No continuity: Having a different clinic and a different provider for prenatal and well-childcare. No other information was provided.
Outcome measures	Vaccine uptake
Number of participants	187
Duration of follow-up	Vaccination status at 1 year of age. There was no follow-up period because this was a retrospective study.
Loss to follow-up	None
Additional comments	Data was provided for completion at 7 and 12 months of age for DTP, polio, Hib, HepB, and all of them. For this evidence review, we only used data for completion of all of them at 12 months of age because this was the most summative data.

Study arms

Provider continuity (N = 44)
Clinic continuity (N = 77)
No continuity (N = 66)

Characteristics

Arm-level characteristics

	Provider continuity (N = 44)	**Clinic continuity (N = 77)**	**No continuity (N = 66)**
% Female *(%)*			
Nominal	43.2	53.3	51.5

Section	**Question**	**Answer**
1. Bias due to confounding	Risk of bias judgement for confounding	Low
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low
5. Bias due to missing data	Risk of bias judgement for missing data	Low
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Moderate *(No information was provided as to how data was collected.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low

Section	Question	Answer
Overall bias	Risk of bias judgement	Serious *(No information was provided as to how data was collected. This is a retrospective cohort study.)*
	Directness	Directly applicable

Kerpelman, 2000

Bibliographic Reference	Kerpelman LC; Connell DB; Gunn WJ; Effect of a monetary sanction on immunization rates of recipients of aid to families with dependent children.; JAMA; 2000; vol. 284 (no. 1)

Study details

Study type	Randomised controlled trial (RCT)
Study location	USA
Study setting	Community
Study dates	1995 to 1998
Sources of funding	Georgia Department of Human Resources
Inclusion criteria	Families with children aged 6 years or younger. (However, series completion data was measured at 2 years of age.)
Exclusion criteria	None
Intervention(s)	Families who either applied or reapplied for Aid to Families with Dependent Children (AFDC) benefits were told that they had to provide proof of up-to-date immunizations for their preschool-aged children. They were reminded of their obligation both when they applied and when they were recertified for welfare eligibility, which was required semi-annually until 1996, when it became an annual requirement. If the family did not present such proof without good cause, such as having religious objections or known allergic reactions, a sanction could be applied after oral or written warnings were issued. The sanction was losing AFDC benefits normally provided for the nonimmunized child. Medicaid benefits and those for Early Periodic Screening, Diagnosis, and Treatment were not affected.
Comparator	Usual care: Case families in the control group were encouraged to immunize their preschool children but were not informed of any aid sanctions nor did such sanctions apply to them.
Outcome measures	Vaccine uptake
Number of participants	850
Duration of follow-up	Follow-up occurred when the children were 2 years old for the series completion data.
Loss to follow-up	None
Additional comments	Vaccine uptake data included the following vaccines: DTP, polio, MMR, Hib, HepB The study included data for the uptake of each vaccine separately. This data was excluded in favour of series completion at 2 years old. This is because this data provided a better overall summary of the study's result.

Study arms

Threat of removal of welfare benefit (N = 510)

Encouraging words (N = 340)

Characteristics

Arm-level characteristics

	Threat of removal of welfare benefit (N = 510)	Encouraging words (N = 340)
% Female children *(%)*		
Nominal	51.5	49.9

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low *(Although the method of randomisation is not provided, the baseline characteristics of the participants in both arms appears balanced.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Low
Domain 2b: Risk of bias due to deviations from the intended interventions (effect of adhering to intervention)	Risk of bias judgement for deviations from the intended interventions (effect of adhering to intervention)	Low
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	Low
	Overall Directness	Directly applicable

Landis, 1995

Bibliographic Reference	Landis, S; Scarbrough, ML; Using a vaccine manager to enhance in-hospital vaccine administration; Journal of family practice; 1995; vol. 41 (no. 4); 364-369

Study details

Study type	Non-randomised controlled trial
Study location	USA
Study setting	Hospital wards
Study dates	1993
Sources of funding	Kate B. Reynolds Charitable Trust
Inclusion criteria	Individuals admitted into hospital: People admitted onto wards for adults. Adult age was not defined.
Intervention(s)	Vaccine-manager strategy placed the responsibility for dispensing the vaccines with a family nurse practitioner, who used a standard protocol form signed by a physician on the medical staff. It did not require the signature of the attending physician.

	Vaccine education, informed consent, documentation, and vaccine administration were accomplished by the nurse without unit staff involvement. The hospital hired a family nurse practitioner who was able to independently assess the need for and then administer vaccines to patients following a predesigned protocol.
Comparator	The enhanced usual care strategy involved integrating immunisation history, patient education and consent, and vaccine administration into the daily activities of nurses and physicians without using additional staff. Floor nurses asked patients about their vaccine history, assessed their age and medical problems based on their medical problem list, and indicated on the adult vaccine order form which vaccines were needed. Attending physicians were then asked to complete and sign the vaccine order form.
Outcome measures	Vaccine uptake
Number of participants	1252
Duration of follow-up	Data was collected at the end of the 3-month study period.
Loss to follow-up	None
Additional comments	This study was included because the mean age was over 50 years. People were not selected because they were considered high risk. This study had data for Td, pneumococcal, rubella, and measles vaccines. For this evidence review, only data for pneumococcal vaccine was relevant to the UK population aged 65 years and over. In the study, the percentage who received the pneumococcal vaccine was from the population who needed one or more vaccines. Therefore, we calculated the percentage uptake of the intention to treat population in the following way: the vaccine manager group had 431 participants. Of these, 46.6% needed any vaccine (201 participants). Of these 201 participants, 31.9% received a pneumococcal vaccine (64 participants). The enhanced usual care group had 821 participants. Of these, 33.1% needed any vaccine (272 participants). Of these 272 participants, 4.1% received a pneumococcal vaccine (11 participants).

1

2 **Study arms**

Vaccine-manager group (N = 431)
Enhanced usual care group (N = 821)

3 **Characteristics**

4 **Arm-level characteristics**

	Vaccine-manager group (N = 431)	**Enhanced usual care group (N = 821)**
% Female *(%)*		
Nominal	54.8	62.9
Mean age *(years)*		
Nominal	57.22	52.77

Section	**Question**	**Answer**
1. Bias due to confounding	Risk of bias judgement for confounding	Low

Section	Question	Answer
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Serious *(The baseline characteristics for each arm were different, for example gender. The participants were recruited from hospital wards. Some of the wards may have had participants for whom vaccines were part of management. Was not an even number of similar wards to place into the 2 arms.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low
5. Bias due to missing data	Risk of bias judgement for missing data	Low
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Serious *(There was no blinding at data collection and data collection required effort. Data collection was done by a vaccine manager. Therefore, this could have introduced bias in favour of the vaccine manager group.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low
Overall bias	Risk of bias judgement	Serious *(Issues with recruitment and data collection.)*
	Directness	Directly applicable

Llamas, 2020 et al.

Bibliographic Reference	Llamas A; Amirthalingam G; Andrews N; Edelstein M; Delivering prenatal pertussis vaccine through maternity services in England: What is the impact on vaccine coverage?; Vaccine; vol. 38 (no. 33)

Study details

Study type	Retrospective cohort study
Study location	UK
Study setting	Maternity services (and general practices as usual care)
Study dates	2017 to 2018
Sources of funding	Not mentioned
Inclusion criteria	Pregnant women: Clinical commissioning groups managing pregnant women.
Exclusion criteria	None
Intervention(s)	Clinical commissioning groups using maternity services to offer pertussis vaccine to pregnant women. Following the 2016 Public Health England (PHE) and the National

	Health Service-England (NHS-E) recommendation to commission maternity services to deliver pertussis vaccine to improve coverage, some maternity services started offering the vaccine from April 2017. Responses on delivery mechanisms for the 20 maternity services for which data was available showed a range of models were used, with some maternity services using more than one model: 19 (95%) offered the vaccine in the hospital antenatal clinic, 12 (55%) during scan appointments, 7 (35%) during routine antenatal appointments, 1 (5.0%) through extra appointments, and 4 (20.0%) opportunistically on Day Assessment Units, antenatal wards, or drop-off clinics in hospital.
Comparator	Clinical commissioning groups not using maternity services to offer pertussis vaccine to pregnant women. The vaccine was delivered exclusively through primary care (as was the case before the PHE and NHS-E 2016 recommendation).
Outcome measures	Vaccine uptake
Number of participants	587502
Duration of follow-up	Data was collected electronically from primary care records. This relied on communication between maternity services and general practices. Among the 37 maternity services for which information on data transfer was available, 19 (51.4%) sent a letter to the patient's GP, 14 (37.8%) recorded vaccination in maternity service notes which can be viewed by GPs, 7 (18.9%) regularly sent a list of all women vaccinated to the GPs, 4 (10.8%) had an automated data transfer mechanism in place, and in 3 (8.1%) another method of data transfer is used.
Loss to follow-up	None
Additional comments	This study presented data separately for maternity services for which pertussis vaccine availability was unclear. We did not include this data because it did not have a clear intervention. This study had a subgroup of clinical commissioning groups that used maternity services that had "reliable data transfer" because they had either automated data transfer methods or sent GPs a list of women who had been immunised against pertussis. We did not use this subgroup as the intervention arm. This is because this subgroup was selected once the data had been collected and analysed, and the baseline pertussis vaccination rate was significantly lower for this subgroup compared to that for the control group (52.9% versus 64.5%). This suggests that the reliable data transfer maternity subgroup had a pre-existing difference compared to the usual care group.

1

2 **Study arms**

Clinical commissioning groups implementing maternity services to offer pertussis vaccinations (N = 386762)
Clinical commissioning groups not implementing maternity services to offer pertussis vaccinations (control, usual care) (N = 200740)

3 **Characteristics**

4 **Arm-level characteristics**

	Clinical commissioning groups implementing maternity services to offer pertussis vaccinations (N = 386762)	Clinical commissioning groups not implementing maternity services to offer pertussis vaccinations (control, usual care) (N = 200740)
Baseline pertussis vaccine uptake *(%)*		
Nominal	61.2	64.5

1

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Moderate *(The only baseline characteristic reported was pre-existing pertussis vaccine uptake.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low
5. Bias due to missing data	Risk of bias judgement for missing data	Low
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Serious *(The investigators suspected that some maternity services did not inform GPs when pertussis vaccines had been given.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low
Overall bias	Risk of bias judgement	Serious *(Issues with data collection)*
	Directness	Directly applicable

2

Mantzari, 2015

3

Bibliographic Reference	Mantzari, Eleni; Vogt, Florian; Marteau, Theresa M; Financial incentives for increasing uptake of HPV vaccinations: a randomized controlled trial.; Health psychology : official journal of the Division of Health Psychology, American Psychological Association; 2015; vol. 34 (no. 2); 160-71

4 **Study details**

Trial registration number and/or trial name	ISRCTN52339409
Study type	Randomised controlled trial (RCT)
Study location	UK
Study setting	Community clinics
Study dates	2008 to 2009

Sources of funding	Birmingham East and North Primary Care Trust
Inclusion criteria	Individuals with a specified age (range) 16- to 18-year-old girls: Registered with participating health centres
Exclusion criteria	Had previously been vaccinated with the vaccine(s) being studied
Intervention(s)	1000 eligible girls were identified, 500 of which had not previously received an invite for vaccination and 500 had previously been sent an invite but had not attended a vaccination session. Girls were separated into two groups, based on whether or not they had previously received an invite, and then randomised into the intervention group (financial incentives and text message reminders) or control group (no financial incentives or reminders). All participants in each group received letters, addressed to them, inviting them to attend their first HPV vaccination session. The letters included the date, time, and venue of their allocated vaccination appointment. Participants were given the option to reschedule their appointment or attend a different immunization clinic by contacting the immunization team at a designated telephone number, included in the letter. Along with the invitation letters, all participants were sent a leaflet containing information about HPV and the HPV vaccine. This was the standard leaflet used and distributed by the NHS. It included information on the prevalence of HPV (i.e., that it is common, with most people getting infected at some point in their life), on how it spreads (i.e., through sexual activity with somebody who has the virus), on the different types of HPV that exist and their relationship to cervical cancer (i.e., that more than 100 types of HPV exist, but only 13 are known to cause cancer, with others being harmless or causing conditions such as genital warts), on the benefit of the HPV vaccine (i.e., that it reduces the risk of getting cervical cancer by 70%), on the limited protection afforded by it (i.e., that it protects against only the two types of the virus most often linked to cancer, but not against others or other sexually transmitted diseases, and does not prevent pregnancy), as well as on the consequences of getting vaccinated (i.e., the vaccine's side effects— described as few and mild—and the continued need to undergo cervical cancer screening in the future). Participants wishing to obtain further information were directed to the relevant NHS Website. Participants in the intervention groups received an invitation letter, which included the offer of Love2Shop vouchers worth £45 for receiving the three vaccinations. The vouchers could be exchanged at numerous stores in the UK, including general merchandise and department stores; fashion and footwear retailers; specialist retailers (e.g., bookstores); jewellery shops; sports, outdoor, and motoring stores; home improvement and soft furnishing stores; restaurants; and leisure facilities (e.g., cinemas). Participants were offered £20 for receiving the first vaccination, £5 for the second vaccination, and £20 for the third vaccination. Reminder text messages: Participants in the intervention groups received text messages reminding them of their second and third vaccination sessions. These were sent during the intervals between the first and second vaccinations, and between the second and third vaccinations, and 2 days prior to the next session. The wording of these messages was, "(Name), don't forget your HPV jab on (day) at (time) at the (venue). Thank you." Participants were not able to reply to these messages.
Comparator	Like the intervention arms, the control arms also received the reminder letter and information about HPV vaccine.

	Participants in the control arms did not receive the financial incentives or reminder text messages.
Number of participants	1000
Duration of follow-up	Not provided
Loss to follow-up	None
Additional comments	Baseline characteristics were not provided.

Study arms

Financial incentives for each of the 3 HPV vaccine doses plus reminder text messages for the second and third HPV doses (People who had not previously received an invite for vaccination) (N = 250)
Control (invitation letter and information leaflet that was sent to participants in both arms) (People who had not previously received an invite for vaccination) (N = 250)
Financial incentives for each of the 3 HPV vaccine doses plus reminder text messages for the second and third HPV doses (People who had previously received an invite for vaccination but not attended a vaccination session) (N = 250)
Control (invitation letter and information leaflet that was sent to participants in both arms) (People who had previously received an invite for vaccination but not attended a vaccination session) (N = 250)

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Low
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Low
Domain 2b: Risk of bias due to deviations from the intended interventions (effect of adhering to intervention)	Risk of bias judgement for deviations from the intended interventions (effect of adhering to intervention)	Low
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	High *(The method of data collection and the follow-up periods were not provided.)*
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	Some concerns *(Some concerns with data collection)*
	Overall Directness	Directly applicable

Minkovitz, 1999

Bibliographic Reference	Minkovitz, C; Holt, E; Hughart, N; Hou, W; Thomas, L; Dini, E; Guyer, B; The effect of parental monetary sanctions on the vaccination status of young children: an evaluation of welfare reform in Maryland.; Archives of pediatrics & adolescent medicine; 1999; vol. 153 (no. 12); 1242-7

Study details

Study type	Randomised controlled trial (RCT)
Study location	USA
Study setting	Community
Study dates	1992 to 1994
Sources of funding	US Department of Health and Human Services and the Centers for Disease Control and Prevention.
Inclusion criteria	Individuals with a specified age (range): Children aged 3 to 24 months. Participants lived in a specified area: Families eligible for the evaluation were served by 1 of 6 Maryland Department of Social Services offices, 4 in metropolitan areas and 2 in rural counties.
Exclusion criteria	None
Intervention(s)	When a family applied for Aid to Families With Dependent Children (AFDC), the case worker reviewed the Primary Prevention Initiative (PPI) requirements. Agreements with Medical Assistance (MA) providers specified that children be seen within a specified time and that sanctioned clients be given priority. At each 6-month redetermination, the case worker ascertained whether the client met the requirements. If clients did not provide verification, they might elect to delay the disallowance for good cause. Good-cause exemptions could last up to 3 months, with a total limit of 2. Noncompliant families were sent an official notice before penalties were imposed.
Comparator	Control (no intervention)
Outcome measures	Vaccine uptake
Number of participants	853
Duration of follow-up	The follow-up period was not provided.
Loss to follow-up	In the intervention arm, 31 medical records were not assessed. In the control arm, 35 medical records were not assessed. Data for these participants has not been included in the analysis because we do not know whether they were vaccinated or not.
Additional comments	No baseline characteristics were provided. The study had year 1 and year 2 data. Year 2 data was used in preference to year 1 data because the intervention had not been properly implemented in year 1. Data was provided for DTP, polio and MMR vaccine separately - an overall completion rate was not provided.

Study arms

Threat of removal of welfare benefit (N = 442)
Control (N = 411)

Section	Question	Answer
Domain 1: Bias arising from the randomisation process	Risk of bias judgement for the randomisation process	Some concerns *(The method of randomisation was not provided. It is not possible to assess randomisation because no baseline characteristics were provided.)*
Domain 2a: Risk of bias due to deviations from the intended interventions (effect of assignment to intervention)	Risk of bias for deviations from the intended interventions (effect of assignment to intervention)	Low
Domain 2b: Risk of bias due to deviations from the intended interventions (effect of adhering to intervention)	Risk of bias judgement for deviations from the intended interventions (effect of adhering to intervention)	Low
Domain 3. Bias due to missing outcome data	Risk-of-bias judgement for missing outcome data	Low
Domain 4. Bias in measurement of the outcome	Risk-of-bias judgement for measurement of the outcome	Low
Domain 5. Bias in selection of the reported result	Risk-of-bias judgement for selection of the reported result	Low
Overall bias and Directness	Risk of bias judgement	Some concerns *(Some concerns with randomisation)*
	Overall Directness	Directly applicable

Perkins, 2016 et al.

Bibliographic Reference	Perkins RB; Lin M; Wallington SF; Hanchate AD; Impact of school-entry and education mandates by states on HPV vaccination coverage: Analysis of the 2009-2013 National Immunization Survey-Teen.; Human vaccines & immunotherapeutics; vol. 12 (no. 6)

Study details

Study type	Retrospective cohort study
Study location	USA
Study setting	Schools
Study dates	2009 to 2013
Sources of funding	Not mentioned
Inclusion criteria	Individuals with a specified age (range) Adolescent girls aged 13 to 17 years of age
Exclusion criteria	None
Intervention(s)	**Intervention 1:** Education mandate. **Intervention 2:** School entry mandate.

	The study does not define what these mandates are. There is no description of the penalty for breaking a mandate. Opting out of a mandate is mentioned as something that people can do, but it does not explain how this can happen.
Comparator	Control - no mandate.
Outcome measures	Vaccine uptake
Number of participants	47845
Duration of follow-up	Data was collected annually, like a 'snapshot'.
Loss to follow-up	None
Additional comments	The investigators adjusted the data for for covariates known to correlate with vaccination coverage: child's and parent's age, race, parent's education level, household income, parent's marital status, parent's primary language, receipt of vaccine in a private or public health facility, insurance status, number of medical visits in the past year, and provider recommendation. We used the pooled data that used weights provided in the data source files. We did not use the estimated annual linear trend estimates because that involved making assumptions about the future after the study had ended. There were no relevant baseline characteristics.

1 **Study arms**

Education mandate (N = 12579)
School entry mandate (N = 1649)
Control (no mandate) (N = 33617)

2

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Low *(The baseline characteristics looked roughly equal for all 3 arms.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Serious *(The interventions were not described.)*
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low
5. Bias due to missing data	Risk of bias judgement for missing data	Low

Section	Question	Answer
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Serious *(Uptake was measured using surveys sent to parents and confirmed with healthcare providers. There is no further information. For example, the investigators did not explain whether providing data was mandatory or whether it was uniformly accurate.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low
Overall bias	Risk of bias judgement	Serious *(There were issues with data collection and with describing the interventions.)*
	Directness	Directly applicable

Zelman, 2014

Bibliographic Reference	Zelman, Mitchell; Sanford, Carolyn; Neatby, Anne; Halperin, Beth A; MacDougall, Donna; Rowswell, Corinne; Langley, Joanne M; Halperin, Scott A; Maritime Universal Rotavirus Vaccination Program, (MURVP); Implementation of a universal rotavirus vaccination program: comparison of two delivery systems.; BMC public health; 2014; vol. 14; 908

Study details

Trial registration number and/or trial name	NCT01273077
Study type	Prospective cohort study
Study location	Canada
Study setting	Public health clinics and family physicians' offices
Study dates	2010 to 2012
Sources of funding	GlaxoSmithKline
Inclusion criteria	Individuals with a specified age (range): Infants (≤1 year old)
Exclusion criteria	None
Intervention(s)	**Public health nurse administered programme in public health clinics:** Rotavirus vaccine was primarily administered along with other routine paediatric vaccines by public health nurses in public health clinics distributed across the province. The implementation process included: an education in-service with immunising public health nurses, notification of physicians and nurse practitioners of the new program, development and distribution of fact sheets to the public and promotional material to physicians and nurse practitioners, and engagement of the media.
Comparator	**Family physician administered programme in family physician offices:** Rotavirus vaccine was provided to family physicians by public health along with other routine paediatric vaccines and was administered in family physicians' offices. Information and educational material was distributed to health care providers who administered the vaccine (mostly primary care physicians). An education needs assessment of providers happened first followed by provider education followed by face-to-face and webinar delivered continuing education

	sessions, direct interaction and discussion with group practices, engaging physicians in project working groups, mailed and electronic communication with physicians, information sheets included with delivery of other routine paediatric vaccines, and media releases directed at the public and providers.
Outcome measures	Vaccine uptake
Number of participants	Approximately 5641. This is an approximation based on yearly birth rates in the areas where the interventions took place during the time of the study.
Duration of follow-up	Uptake at 1 year of age.
Loss to follow-up	None reported
Additional comments	The study provided 2 years of data separately. For the evidence review, only the second year of data was used because during the second year, practices should have been more imbedded. The population numbers are estimates based on official birth figures for the regions where the cohorts were located. No baseline characteristics were provided.

Study arms

Public health nurse administered programme in public health clinics (N = 1432)
Family physician administered programme in family physician offices (N = 4209)

Section	Question	Answer
1. Bias due to confounding	Risk of bias judgement for confounding	Low
2. Bias in selection of participants into the study	Risk of bias judgement for selection of participants into the study	Serious *(The numbers of participants was based on annual birth rates in the areas where the interventions took place during that period of time. No baseline characteristics were reported to assess how similar the 2 cohorts were.)*
3. Bias in classification of interventions	Risk of bias judgement for classification of interventions	Low
4. Bias due to deviations from intended interventions	Risk of bias judgement for deviations from intended interventions	Low
5. Bias due to missing data	Risk of bias judgement for missing data	Low
6. Bias in measurement of outcomes	Risk of bias judgement for measurement of outcomes	Moderate *(No information was provided as to how data was collected.)*
7. Bias in selection of the reported result	Risk of bias judgement for selection of the reported result	Low
Overall bias	Risk of bias judgement	Serious *(Issues with recruitment and outcome measurement.)*
	Directness	Partially directly applicable

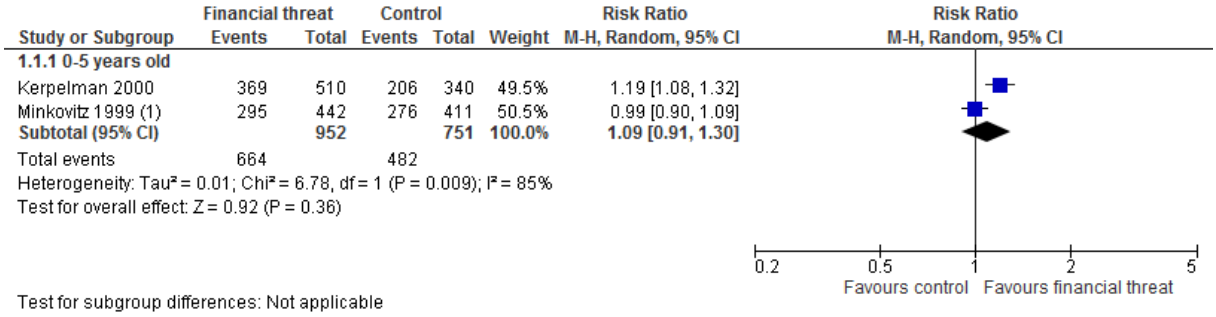
Section	Question	Answer
		(*based in Canada, which has a more widely spread-out population in some areas than the UK. The committee thought this was not particularly generalisable to the UK)*

Appendix E – Forest plots

Infrastructure interventions aimed at individuals, parents and carers compared to control

Financial incentives or penalties

Threat of removal of welfare benefit versus control

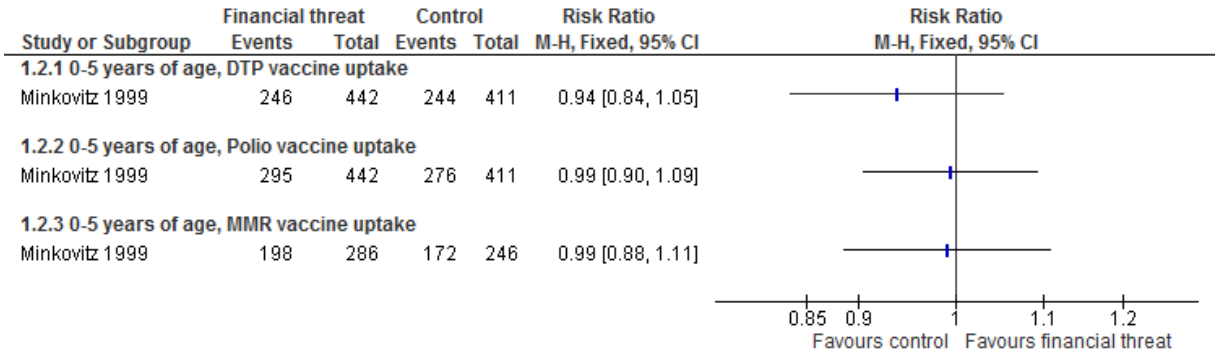


Test for subgroup differences: Not applicable

Footnotes

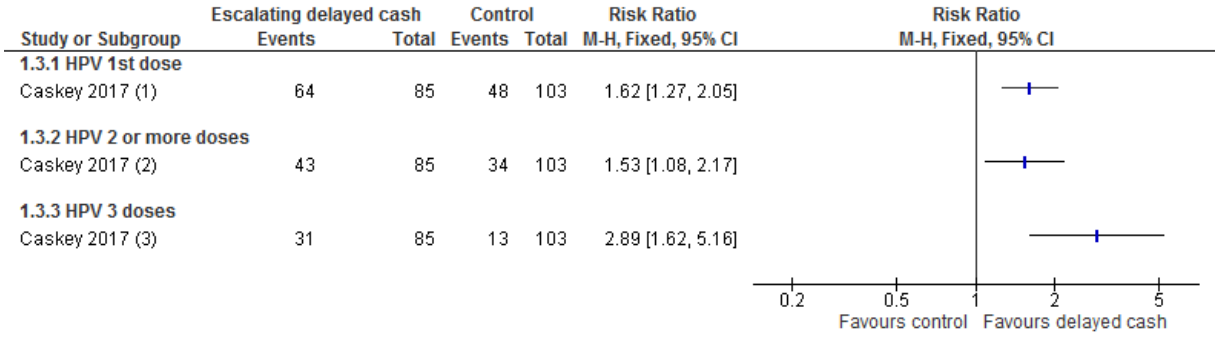
(1) The polio data was used in this meta-analysis because it had the largest number of participants and responders for both arms.

Threat of removal of welfare benefit versus control



NON-RCT: Cash incentive versus control

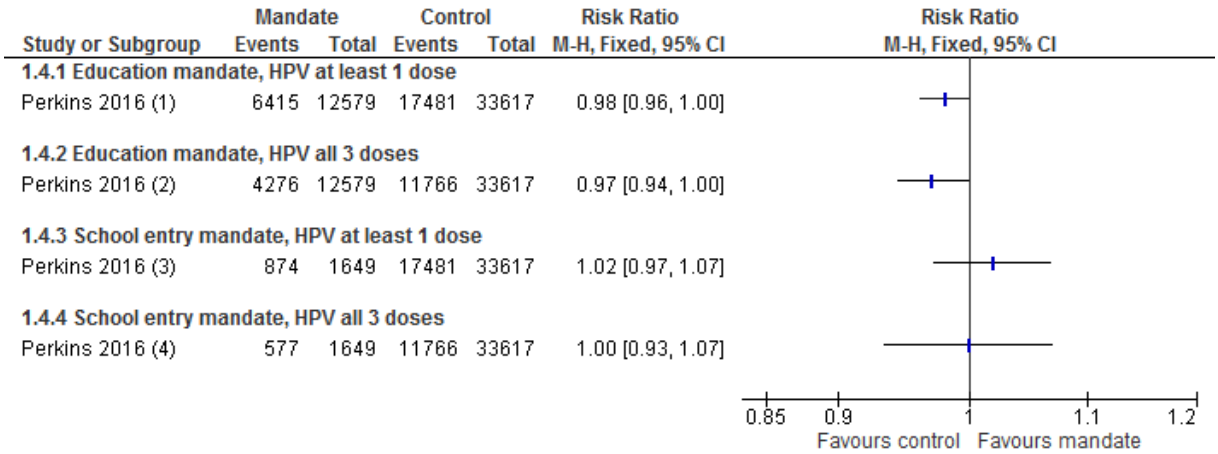
Details of the intervention can be found here.



Footnotes
(1) Non-randomised controlled trial.
(2) Non-randomised controlled trial.
(3) Non-randomised controlled trial.

Education or school entry vaccination mandates

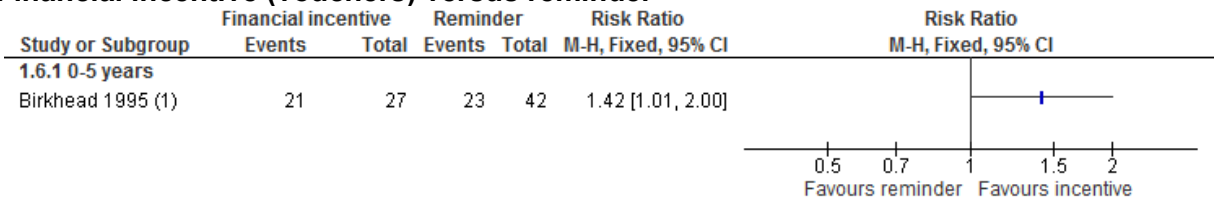
NON-RCT: Education mandate or school entry mandate versus control



Footnotes
(1) Cohort study.
(2) Cohort study.
(3) Cohort study.
(4) Cohort study.

Infrastructure interventions aimed at individuals, parents and carers compared to another intervention

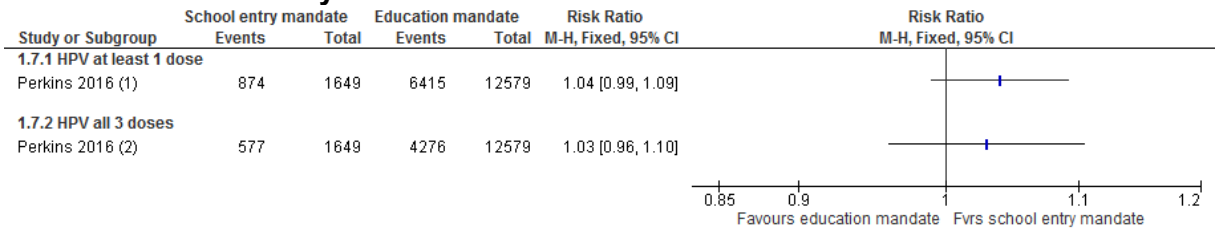
Financial incentive (vouchers) versus reminder



Footnotes

(1) cRCT data was adjusted for clustering. Vouchers were given every month (rather than the normal every 2 months) until the child was immunised. The reminder was a referral for vaccination - no further details were provided.

NON-RCT: School entry mandate versus education mandate

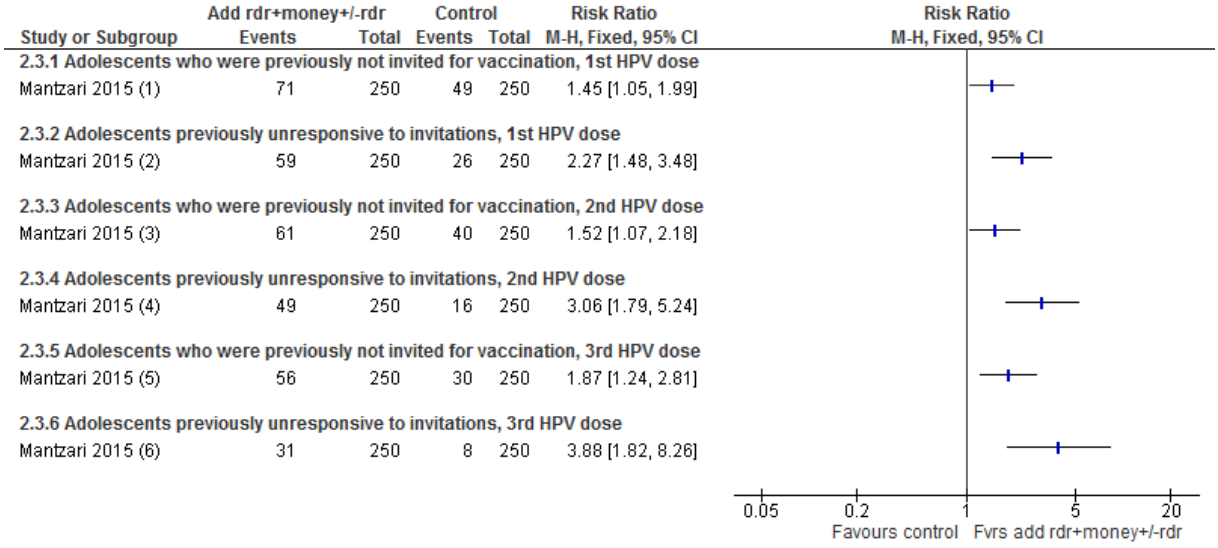


Footnotes
(1) Cohort study.
(2) Cohort study.

Infrastructure intervention plus another intervention aimed at individuals, parents and carers compared to control

Financial incentives with reminders

Additional reminder letter with financial incentives plus reminder text message for 2nd and 3rd HPV dose verses control

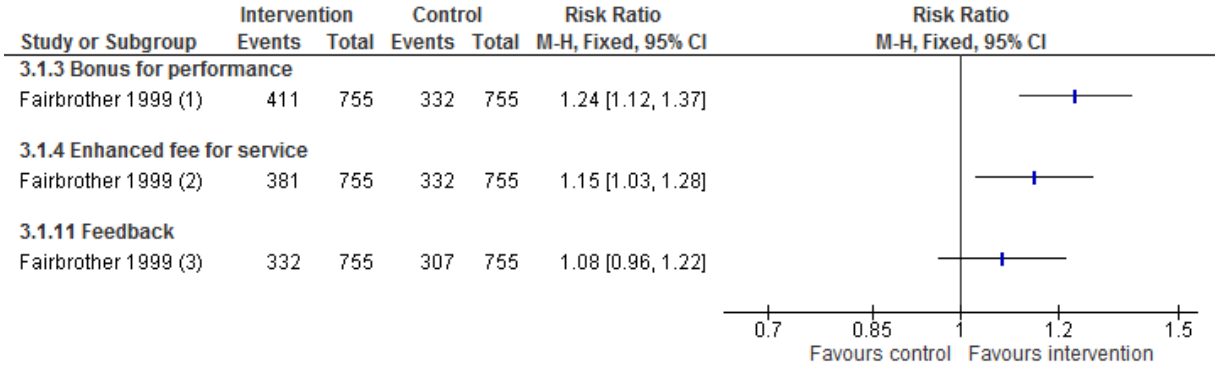


Footnotes
(1) Additional reminder letter with financial incentives.
(2) Additional reminder letter with financial incentives.
(3) Additional reminder letter with financial incentives plus reminder text message for 2nd HPV dose.
(4) Additional reminder letter with financial incentives plus reminder text message for 2nd HPV dose.
(5) Additional reminder letter with financial incentives plus reminder text messages for 2nd and 3rd HPV doses.
(6) Additional reminder letter with financial incentives plus reminder text messages for 2nd and 3rd HPV doses.

Infrastructure interventions aimed at healthcare provider compared to control

Financial incentives or feedback

Interventions aimed at healthcare providers versus control (summary)



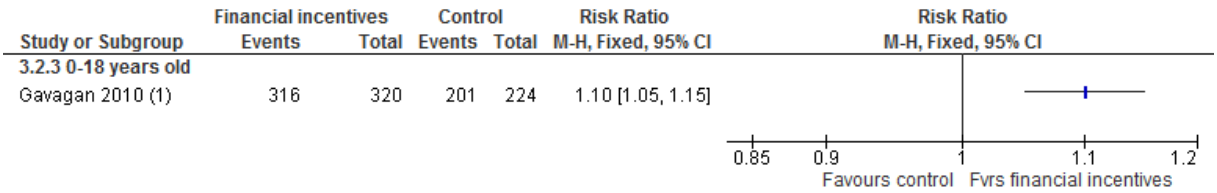
Footnotes

(1) cRCT data was adjusted for clustering. Feedback via letter was in both arms. 0-5 years of age. Arm 1 (bonus and feedback) versus Arm 3 (feedback only)

(2) cRCT data was adjusted for clustering. Feedback via letter was in both arms. 0-5 years of age. Arm 2 (enhanced fee for service and feedback) versus Arm 3 (feedback only)

(3) cRCT data was adjusted for clustering. Feedback was via letter. 0-5 years of age. Arm 3 (feedback only) versus control.

NON-RCT: Financial incentives for physicians versus control



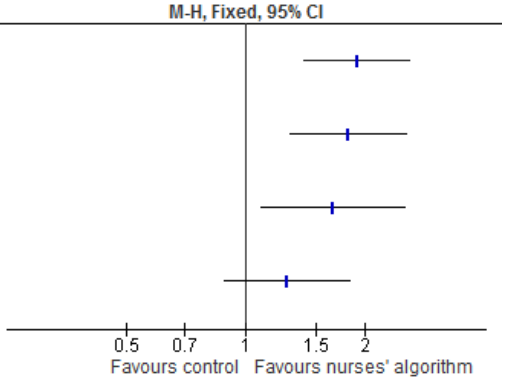
Footnotes

(1) Cohort study. Study measured paediatric vaccinations - age range was not specified.

Processes and systems changes compared to control

NON-RCT: Algorithm to aid vaccination decision making for nurses versus control

Study or Subgroup	Algorithm for nurses Events	Total	Control Events	Total	Risk Ratio M-H, Fixed, 95% CI
1.5.1 0-5 years, DTP					
Christy 1997 (1)	88	302	51	333	1.90 [1.40, 2.59]
1.5.2 0-5 years, polio					
Christy 1997 (2)	69	250	44	289	1.81 [1.29, 2.54]
1.5.3 0-5 years, MMR					
Christy 1997 (3)	38	121	30	158	1.65 [1.09, 2.51]
1.5.4 0-5 years, Hib					
Christy 1997 (4)	57	392	46	402	1.27 [0.88, 1.83]



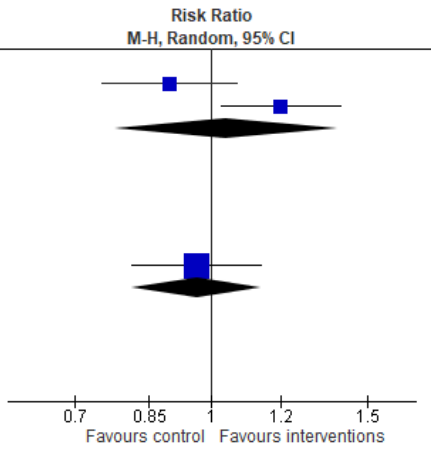
Footnotes
(1) Cohort study
(2) Cohort study.
(3) Cohort study.
(4) Cohort study.

The algorithm can be seen here.

Infrastructure intervention plus other interventions aimed at healthcare providers compared to control

Education, assessment and feedback versus control

Study or Subgroup	Interventions Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
5.1.1 Face-to-face physician education with assessment and feedback						
Gilkey 2014 (1)	165	570	184	570	49.1%	0.90 [0.75, 1.07]
Gilkey 2019 (2)	151	245	126	245	50.9%	1.20 [1.02, 1.40]
Subtotal (95% CI)		**815**		**815**	**100.0%**	**1.04 [0.78, 1.39]**
Total events	316		310			
Heterogeneity: Tau² = 0.04; Chi² = 6.15, df = 1 (P = 0.01); I² = 84%						
Test for overall effect: Z = 0.26 (P = 0.80)						
5.1.3 Webinar education, assessment and feedback						
Gilkey 2014 (3)	180	579	187	579	100.0%	0.96 [0.81, 1.14]
Subtotal (95% CI)		**579**		**579**	**100.0%**	**0.96 [0.81, 1.14]**
Total events	180		187			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.44 (P = 0.66)						

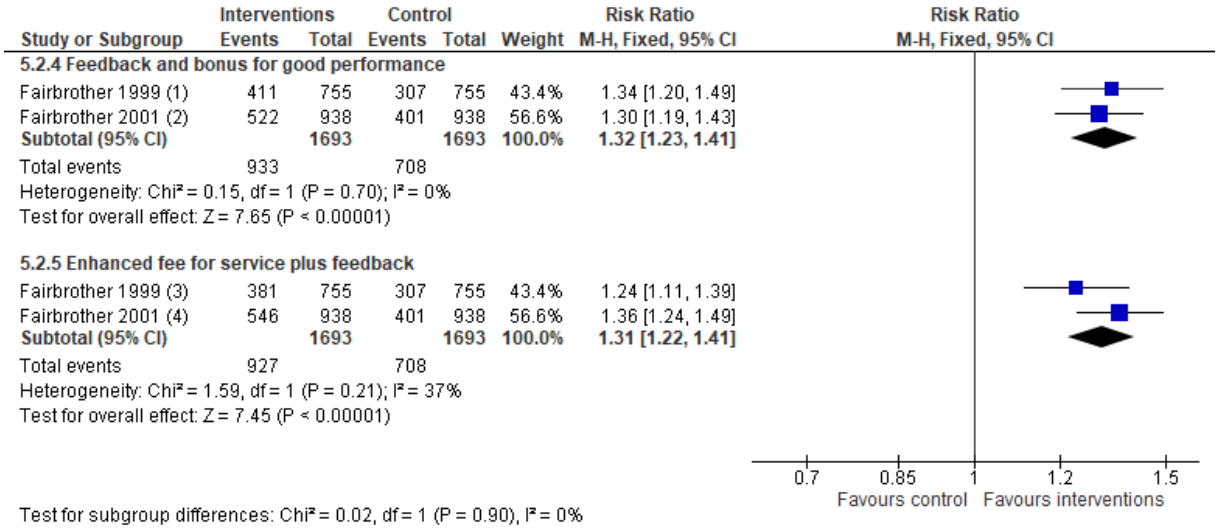


Test for subgroup differences: Chi² = 0.20, df = 1 (P = 0.66), I² = 0%

Footnotes
(1) cRCT data was adjusted for clustering for this review using an ICC of 0.05. The HPV 1st dose data has been selected for this summary. The 11-12 year old data has been used because this age range is closer to the UK routine schedule compared to 13-18 years old.
(2) cRCT data was adjusted for clustering for this review using an ICC of 0.05. 11-18 years old. HPV vaccine, 1 dose or more. Assessment and feedback was done individually. No other details were provided.
(3) cRCT data was adjusted for clustering for this review using an ICC of 0.05. The HPV 1st dose data has been selected for this summary. The 11-12 year old data

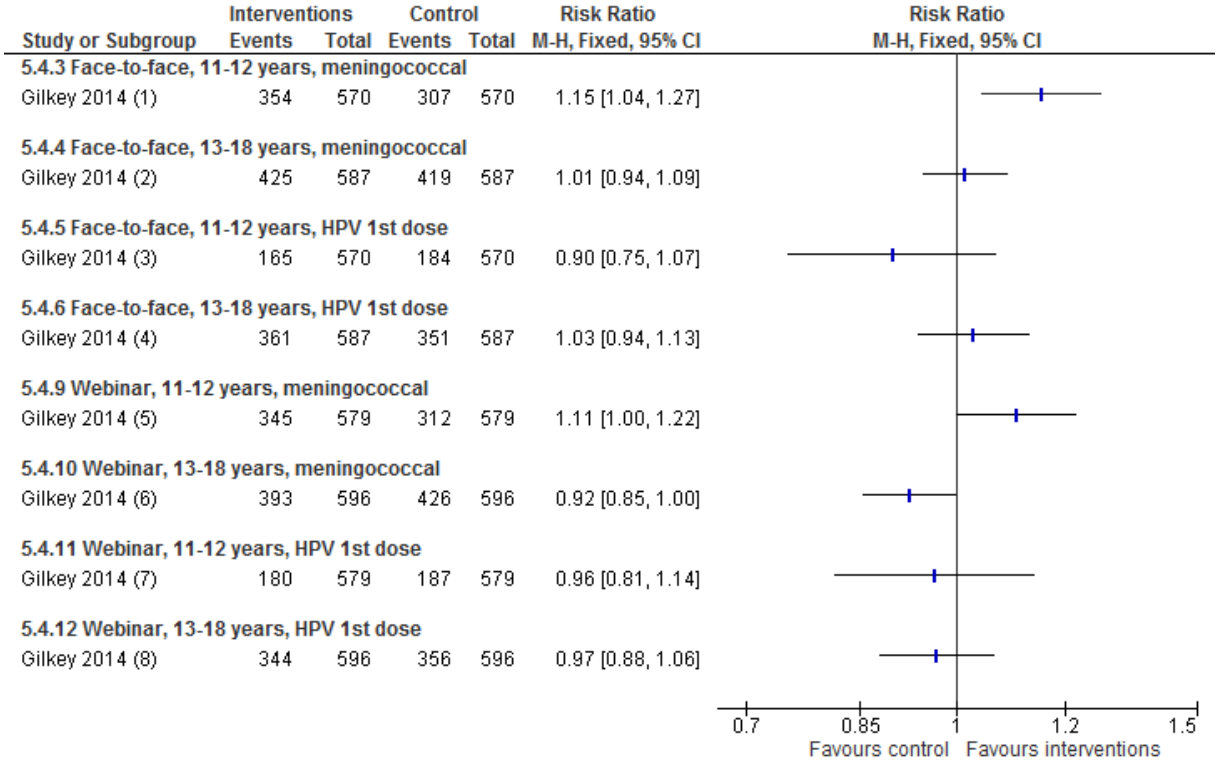
has been used because this age range is closer to the UK routine schedule compared to 13-18 years old.

Feedback and financial incentives versus control



(1) cRCT data was adjusted for clustering by the study authors. Uptake of childhood vaccines 16 months after start of the intervention. Feedback was via letter.
(2) cRCT data was adjusted for clustering by the study authors. Uptake of childhood vaccines 16 months after start of the intervention. Feedback was via letter.
(3) cRCT data was adjusted for clustering by the study authors. Uptake of childhood vaccines 16 months after start of the intervention. Feedback was via letter. Enhanced fee for service and feedback versus control.
(4) cRCT data was adjusted for clustering by the study authors. Uptake of childhood vaccines 16 months after start of the intervention. Feedback was via letter.

Education with assessment and feedback versus control

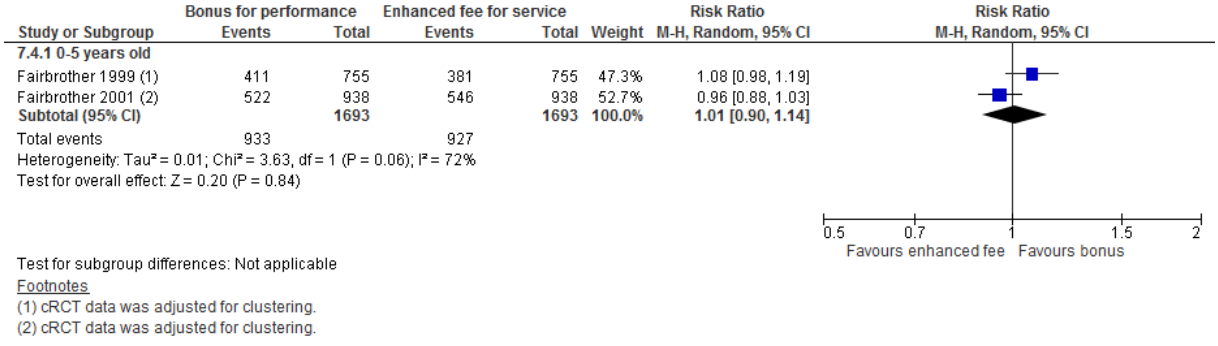


Footnotes

1 to 8: cRCT data was adjusted for clustering for this review using an ICC of 0.05.

Infrastructure interventions aimed at healthcare providers compared to a different intervention

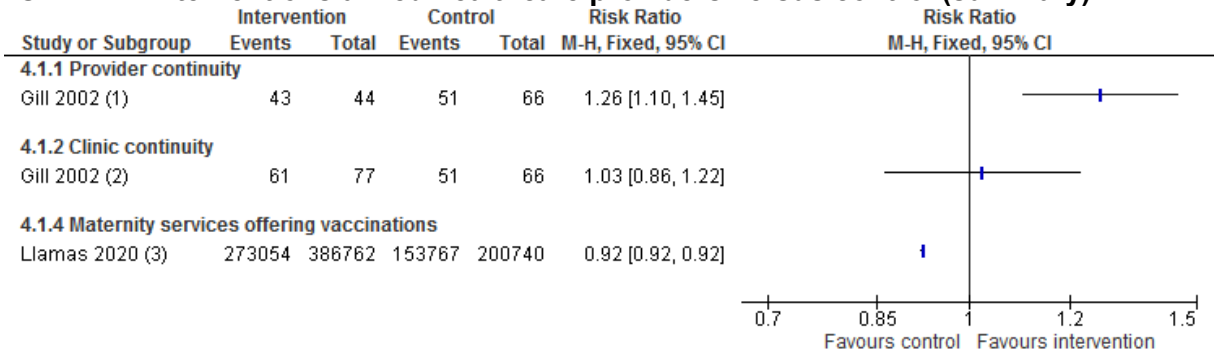
Bonus for performance versus enhanced fee for service



(1) and (2) cRCT data was adjusted for clustering by the study authors. Uptake of childhood vaccines 16 months after start of the intervention.

Infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to control

NON-RCT: Interventions aimed healthcare providers versus control (summary)



Footnotes

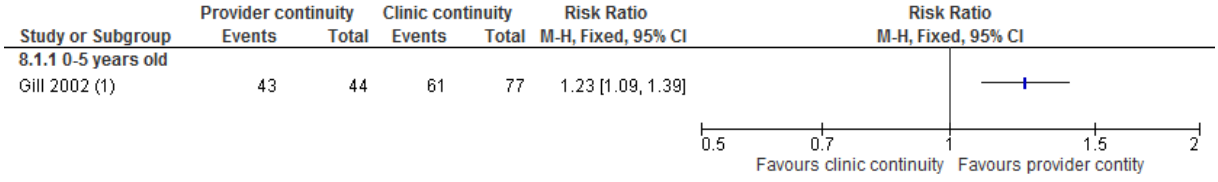
(1) Cohort study. 0-5 years old. Provider continuity means same healthcare professional managed mother before and after birth.

(2) Cohort study. 0-5 years old. Clinic continuity means that a different healthcare professional was managing mother before and after birth, but the clinic was the same before and after.

(3) Cohort study. Pregnant women. CCGs with maternity services offering vaccinations compared to CCGs without maternity services offering vaccinations (offered by GPs as usual care).

Infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to a different intervention

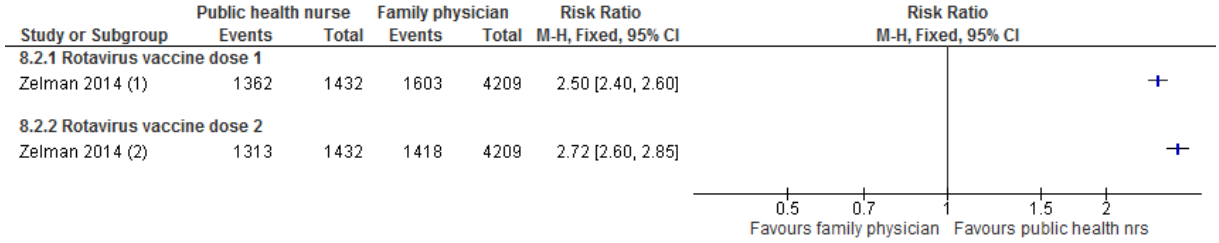
NON-RCT: Provider continuity versus clinic continuity



Footnotes

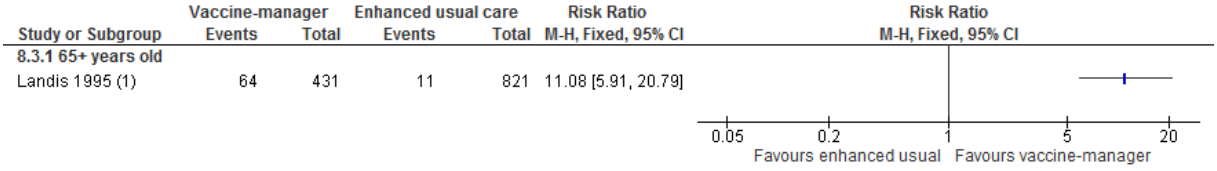
(1) Cohort study

NON-RCT: Public health nurse delivered programme in public health clinics versus family physician delivered programme in family physician offices



Footnotes
(1) Cohort study
(2) Cohort study

NON-RCT: Vaccine-manager group versus enhanced usual care group



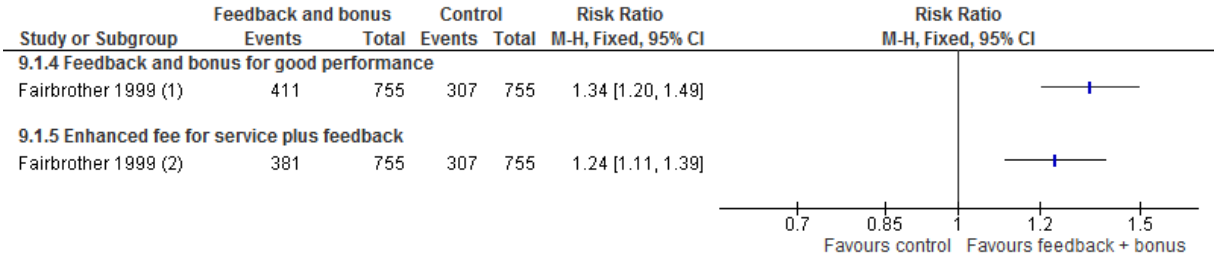
Footnotes
(1) Non-randomised controlled trial.

Sensitivity analysis

These are results that changed after studies were removed from the analysis that had a high risk of bias.

Infrastructure intervention plus another intervention aimed at healthcare providers compared to control

Feedback plus a different intervention versus control

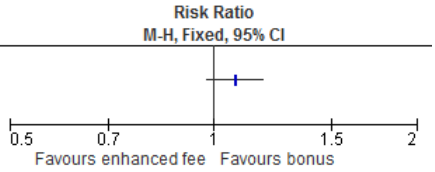


Footnotes
(1) cRCT data was adjusted for clustering. Feedback was via letter.
(2) cRCT data was adjusted for clustering. Feedback was via letter.

Infrastructure interventions aimed at healthcare providers compared to a different intervention

Bonus for performance versus enhanced fee for service

Study or Subgroup	Bonus for performance Events	Total	Enhanced fee for service Events	Total	Risk Ratio M-H, Fixed, 95% CI
10.4.1 0-5 years old					
Fairbrother 1999 (1)	411	755	381	755	1.08 [0.98, 1.19]



Footnotes
(1) cRCT data was adjusted for clustering.

Appendix F – GRADE tables

Infrastructure interventions aimed at individuals, parent and carers compared to control

Financial incentives or penalties

Table 18 GRADE table for financial incentives or penalties

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Threat of removal of welfare benefit versus control (RR >1 favours financial threat)										
0-5 years old										
2 (Kerpelman 2000, Minkovitz 1999)	RCT	1703	RR 1.09 (0.91, 1.30)	64 per 100	70 per 100 (58, 83)	Serious[6]	Not serious	Very serious[2]	Serious[3]	Very low
Threat of removal of welfare benefit versus control (RR >1 favours financial threat)										
0-5 years of age, DTP vaccine uptake										
1 (Minkovitz 1999)	RCT	853	RR 0.94 (0.84, 1.05)	59 per 100	56 per 100 (50, 62)	Serious[1]	Not serious	N/A[5]	Serious[3]	Low
0-5 years of age, Polio vaccine uptake										
1 (Minkovitz 1999)	RCT	853	RR 0.99 (0.90, 1.09)	67 per 100	66 per 100 (60, 73)	Serious[1]	Not serious	N/A[5]	Serious[3]	Low
0-5 years of age, MMR vaccine uptake										
1 (Minkovitz 1999)	RCT	532	RR 0.99 (0.88, 1.11)	70 per 100	69 per 100 (62, 78)	Serious[1]	Not serious	N/A[5]	Serious[3]	Low
NON-RCT: Cash incentive versus control (RR >1 favours delayed cash)										

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
HPV 1st dose										
1 (Caskey 2017)	Quasi-randomised controlled trial	188	RR 1.62 (1.27, 2.05)	47 per 100	75 per 100 (59, 96)	Very serious[4]	Not serious	N/A[5]	Not serious	Low
HPV 2 or more doses										
1 (Caskey 2017)	Quasi-randomised controlled trial	188	RR 1.53 (1.08, 2.17)	33 per 100	51 per 100 (36, 72)	Very serious[4]	Not serious	N/A[5]	Not serious	Low
HPV 3 doses										
1 (Caskey 2017)	Quasi-randomised controlled trial	188	RR 2.89 (1.62, 5.16)	13 per 100	36 per 100 (20, 65)	Very serious[4]	Not serious	N/A[5]	Not serious	Low

1. Downgraded once: Single study at moderate risk of bias.
2. Downgraded twice for inconsistency: the I^2 was greater than 66.7%.
3. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.
4. Downgraded twice: Single study at high risk of bias.
5. Single study. Inconsistency not applicable.
6. Downgraded once: greater than 33.3% of the weight of the meta-analysis came from studies at moderate or high risk of bias.

Education or school entry vaccination mandates

Table 19 GRADE table for education or school entry vaccination mandates

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
NON-RCT: Education mandate or school entry mandate versus control (RR >1 favours mandate)										
Education mandate, HPV at least 1 dose										
1 (Perkins 2016)	Cohort study	46196	RR 0.98 (0.96, 1.00)	52 per 100	51 per 100 (50, 52)	Very serious[1]	Not serious	N/A[3]	Not serious	Low
Education mandate, HPV all 3 doses										
1 (Perkins 2016)	Cohort study	46196	RR 0.97 (0.94, 1.00)	35 per 100	34 per 100 (33, 35)	Very serious[1]	Not serious	N/A[3]	Not serious	Low
School entry mandate, HPV at least 1 dose										
1 (Perkins 2016)	Cohort study	35266	RR 1.02 (0.97, 1.07)	52 per 100	53 per 100 (50, 56)	Very serious[1]	Not serious	N/A[3]	Serious[2]	Very low
School entry mandate, HPV all 3 doses										
1 (Perkins 2016)	Cohort study	35266	RR 1.00 (0.93, 1.07)	35 per 100	35 per 100 (33, 37)	Very serious[1]	Not serious	N/A[3]	Serious[2]	Very low

1. Downgraded twice: Single study at high risk of bias.
2. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.
3. Single study. Inconsistency not applicable.

Infrastructure interventions aimed at individuals, parents and carers compared to another intervention

Table 20 GRADE table for infrastructure interventions aimed at individuals, parents and carers compared to another intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Financial incentive (vouchers) versus reminder (RR >1 favours financial incentive)										

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
0-5 years										
1 (Birkhead 1995)	cRCT[6]	69	RR 1.42 (1.01, 2.00)	55 per 100	78 per 100 (55, 100)	Serious[1]	Serious[2]	N/A[5]	Not serious	Low
NON-RCT: School entry mandate versus education mandate (RR >1 favours school entry mandate)										
HPV at least 1 dose										
1 (Perkins 2016)	Cohort study	14228	RR 1.04 (0.99, 1.09)	51 per 100	53 per 100 (50, 56)	Very serious[3]	Not serious	N/A[5]	Serious[4]	Very low
HPV at least 3 doses										
1 (Perkins 2016)	Cohort study	14228	RR 1.03 (0.96, 1.10)	34 per 100	35 per 100 (33, 37)	Very serious[3]	Not serious	N/A[5]	Serious[4]	Very low

1. Downgraded once: Single study at moderate risk of bias.
2. Downgraded once: greater than 33.3% of the weight of the meta-analysis came from studies that were partially direct or indirect.
3. Downgraded twice: Single study at high risk of bias.
4. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.
5. Single study. Inconsistency not applicable.
6. Birkhead 1995 data was adjusted for clustering in this review using an ICC of 0.05.

1

Infrastructure intervention plus another intervention aimed at individuals, parents and carers compared to control

Financial incentives with reminders

Table 21 GRADE table for financial incentives with reminders

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Financial incentives plus reminder text message for 2nd and 3rd HPV dose verses control (RR >1 favours intervention)										
Adolescents who were previously not invited for vaccination, 1st HPV dose										
1 (Mantzari 2015)	RCT	500	RR 1.45 (1.05, 1.99)	20 per 100	28 per 100 (21, 39)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate
Adolescents previously unresponsive to invitations, 1st HPV dose										
1 (Mantzari 2015)	RCT	500	RR 2.27 (1.48, 3.48)	10 per 100	24 per 100 (15, 36)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate
Adolescents who were previously not invited for vaccination, 2nd HPV dose										
1 (Mantzari 2015)	RCT	500	RR 1.52 (1.07, 2.18)	16 per 100	24 per 100 (17, 35)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate
Adolescents previously unresponsive to invitations, 2nd HPV dose										
1 (Mantzari 2015)	RCT	500	RR 3.06 (1.79, 5.24)	6 per 100	20 per 100 (11, 34)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate
Adolescents who were previously not invited for vaccination, 3rd HPV dose										
1 (Mantzari 2015)	RCT	500	RR 1.87 (1.24, 2.81)	12 per 100	22 per 100 (15, 34)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate
Adolescents previously unresponsive to invitations, 3rd HPV dose										

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
1 (Mantzari 2015)	RCT	500	RR 3.88 (1.82, 8.26)	3 per 100	12 per 100 (6, 26)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate

1. Downgraded once: Single study at moderate risk of bias.
2. Single study. Inconsistency not applicable.

1

Infrastructure interventions aimed at healthcare provider compared to control

Financial incentives or feedback

Table 22 GRADE table for interventions aimed at healthcare provider compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Financial incentives or feedback										
Interventions aimed at healthcare providers versus control (summary) (RR >1 favours intervention)										
Bonus for performance										
1 (Fairbrother 1999)	cRCT[5]	1510	RR 1.24 (1.12, 1.37)	44 per 100	55 per 100 (49, 60)	Serious[1]	Not serious	N/A[4]	Not serious	Moderate
Enhanced fee for service										
1 (Fairbrother 1999)	cRCT[5]	1510	RR 1.15 (1.03, 1.28)	44 per 100	51 per 100 (45, 56)	Very serious[2]	Not serious	N/A[4]	Not serious	Low
Feedback										
1 (Fairbrother 1999)	cRCT[5]	1510	RR 1.08 (0.96, 1.22)	41 per 100	44 per 100 (39, 50)	Very serious[2]	Not serious	N/A[4]	Serious[3]	Very low
NON-RCT: Financial incentives for physicians versus control (RR >1 favours financial incentive for physicians)										
0-18 years old										
1 (Gavagan 2010)	Cohort study	544	RR 1.10 (1.05, 1.15)	90 per 100	99 per 100 (94, 100)	Very serious[4]	Not serious	N/A[4]	Not serious	Low

1. Downgraded once: Single study at moderate risk of bias.
2. Downgraded twice: Single study at high risk of bias. Comparisons with data from the enhanced fee for service and feedback groups were graded as high risk of bias due to problems with randomisation.
3. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality

4. Single study. Inconsistency not applicable.
5. Fairbrother 1999 was adjusted by the investigators for clustering.

1 Processes and systems changes compared to control

2 Table 23 GRADE table for processes and systems changes compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
NON-RCT: Algorithm to aid vaccination decision making for nurses versus control (RR >1 favours nurses' algorithm)										
0-5 years, DPT										
1 (Christy 1997)	Cohort study	635	RR 1.90 (1.40, 2.59)	15 per 100	29 per 100 (21, 40)	Very serious[1]	Not serious	N/A[3]	Not serious	Low
0-5 years, polio										
1 (Christy 1997)	Cohort study	539	RR 1.81 (1.29, 2.54)	15 per 100	28 per 100 (20, 39)	Very serious[1]	Not serious	N/A[3]	Not serious	Low
0-5 years, MMR										
1 (Christy 1997)	Cohort study	279	RR 1.65 (1.09, 2.51)	19 per 100	31 per 100 (21, 48)	Very serious[1]	Not serious	N/A[3]	Not serious	Low
0-5 years, Hib										
1 (Christy 1997)	Cohort study	794	RR 1.27 (0.88, 1.83)	11 per 100	15 per 100 (10, 21)	Very serious[1]	Not serious	N/A[3]	Serious[2]	Very low

1. Downgraded twice: Single study at high risk of bias.
2. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.
3. Single study. Inconsistency not applicable.

Infrastructure intervention plus other interventions aimed at healthcare providers compared to control

Table 24 GRADE table for intervention plus another intervention aimed at healthcare providers compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Education, assessment and feedback versus control (RR >1 favours interventions)										
Face-to-face physician education with assessment and feedback										
2 (Gilkey 2014, Gilkey 2019)	cRCT[6]	1630	RR 1.04 (0.78, 1.39)	38 per 100	40 per 100 (30, 53)	Serious[1]	Not serious	Very serious[2]	Serious[3]	Very low
Webinar education, assessment and feedback										
1 (Gilkey 2014)	cRCT[6]	1158	RR 0.96 (0.81, 1.14)	32 per 100	31 per 100 (26, 37)	Not serious	Not serious	N/A	Serious[3]	Moderate
Feedback and financial incentives versus control (RR >1 favours interventions)										
Feedback and bonus for good performance										
2 (Fairbrother 1999, Fairbrother 2001)	cRCT[7]	3386	RR 1.32 (1.23, 1.41)	42 per 100	55 per 100 (51, 59)	Very serious[4]	Not serious	Not serious	Not serious	Low
Enhanced fee for service plus feedback										
2 (Fairbrother 1999, Fairbrother 2001)	cRCT[7]	3386	RR 1.31 (1.22, 1.41)	42 per 100	55 per 100 (51, 59)	Very serious[4]	Not serious	Serious[5]	Not serious	Very low
Education with assessment and feedback versus control (RR >1 favours interventions)										
Face-to-face, 11-12 years, meningococcal										

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
1 (Gilkey 2014)	cRCT[6]	1140	RR 1.15 (1.04, 1.27)	54 per 100	62 per 100 (56, 68)	Not serious	Not serious	N/A	Not serious	High
Face-to-face, 13-18 years, meningococcal										
1 (Gilkey 2014)	cRCT[6]	1174	RR 1.01 (0.94, 1.09)	71 per 100	72 per 100 (67, 78)	Not serious	Not serious	N/A	Serious[3]	Moderate
Face-to-face, 11-12 years, HPV 1st dose										
1 (Gilkey 2014)	cRCT[6]	1140	RR 0.90 (0.75, 1.07)	32 per 100	29 per 100 (24, 35)	Not serious	Not serious	N/A	Serious[3]	Moderate
Face-to-face, 13-18 years, HPV 1st dose										
1 (Gilkey 2014)	cRCT[6]	1174	RR 1.03 (0.94, 1.13)	60 per 100	62 per 100 (56, 68)	Not serious	Not serious	N/A	Serious[3]	Moderate
Webinar, 11-12 years, meningococcal										
1 (Gilkey 2014)	cRCT[6]	1158	RR 1.11 (1.00, 1.22)	54 per 100	60 per 100 (54, 66)	Not serious	Not serious	N/A	Not serious	High
Webinar, 13-18 years, meningococcal										
1 (Gilkey 2014)	cRCT[6]	1192	RR 0.92 (0.85, 1.00)	71 per 100	66 per 100 (61, 71)	Not serious	Not serious	N/A	Not serious	High
Webinar, 11-12 years, HPV 1st dose										
1 (Gilkey 2014)	cRCT[6]	1158	RR 0.96 (0.81, 1.14)	32 per 100	31 per 100 (26, 37)	Not serious	Not serious	N/A	Serious[3]	Moderate
Webinar, 13-18 years, HPV 1st dose										
1 (Gilkey 2014)	cRCT[6]	1192	RR 0.97 (0.88, 1.06)	60 per 100	58 per 100 (53, 63)	Not serious	Not serious	N/A	Serious[3]	Moderate

1. Downgraded once: greater than 33.3% of the weight of the meta-analysis came from studies at moderate or high risk of bias.
2. Downgraded twice for inconsistency: the I^2 was greater than 66.7%.
3. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.
4. Downgraded twice: greater than 33.3% of the weight of the meta-analysis came from studies at high risk of bias.
5. Downgraded once for inconsistency: the I^2 was between 33.3% and 66.6%.
6. Data from Gilkey 2014, Gilkey 2019 was adjusted for clustering for this review using an ICC of 0.05.
7. Data from Fairbrother 1999 and Fairbrother 2001 was adjusted by the study investigators for clustering.

Infrastructure interventions aimed at healthcare providers compared to a different intervention

Table 25 GRADE table for interventions aimed at healthcare providers compared to a different intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Bonus for performance versus enhanced fee for service										
0-5 years old										
2 (Fairbrother 1999, Fairbrother 2001)	cRCT[4]	3386	RR 1.01 (0.90, 1.14)	55 per 100	55 per 100 (49, 62)	Very serious[1]	Not serious	Very serious[2]	Serious[3]	Very low

1. Downgraded twice: greater than 33.3% of the weight of the meta-analysis came from studies at high risk of bias.
2. Downgraded twice for inconsistency: the I^2 was greater than 66.7%.
3. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.
4. Data from Fairbrother 1999 and Fairbrother 2001 was adjusted by the study investigators for clustering.

Infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to control

Table 26 GRADE table for interventions aimed at individuals, parents and carers, and healthcare providers compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
NON-RCT: Interventions aimed at pregnant women, and healthcare providers versus control (summary) (RR >1 favours intervention)										
Provider continuity										

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
1 (Gill 2002)	Cohort study	110	RR 1.26 (1.10, 1.45)	77 per 100*	97 per 100 (85, 100)	Very serious[1]	Not serious	N/A[3]	Not serious	Low
Clinic continuity										
1 (Gill 2002)	Cohort study	143	RR 1.03 (0.86, 1.22)	77 per 100*	80 per 100 (66, 94)	Very serious[1]	Not serious	N/A[3]	Very serious[2]	Very low
Maternity services offering vaccinations										
1 (Llamas 2020)	Cohort study	587502	RR 0.92 (0.92, 0.92)	77 per 100*	70 per 100 (70, 70)	Very serious[1]	Not serious	N/A[3]	Not serious	Low

1. Downgraded twice: single study at high risk of bias.
2. Downgraded twice for imprecision: the 95% confidence interval for the effect size crossed the line of no effect and the total number of participants was <200.
3. Single study. Inconsistency not applicable.

* The 77 per 100 is not an error and represents the absolute effects in the control arms for these trials by coincidence.

Infrastructure interventions aimed at individuals, parents and carers, and healthcare providers compared to a different intervention

Table 27 GRADE table for interventions aimed at individuals, parents and carers, and healthcare providers compared to a different intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
NON-RCT: Provider continuity versus clinic continuity (RR >1 favours provider continuity)										
0-5 years old										
1 (Gill 2002)	Cohort study	121	RR 1.23 (1.09, 1.39)	79 per 100	97 per 100 (86, 100)	Very serious[1]	Not serious	N/A[2]	Not serious	Low
NON-RCT: Public health nurse delivered programme in public health clinics versus family physician delivered programme in family physician offices (RR >1 favours public health nurse delivered programme in public health clinics)										
Rotavirus vaccine dose 1										

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
1 (Zelman 2014)	Cohort study	5641	RR 2.50 (2.40, 2.60)	38 per 100	95 per 100 (91, 99)	Very serious[1]	Serious[3]	N/A[2]	Not serious	Very low
Rotavirus vaccine dose 2										
1 (Zelman 2014)	Cohort study	5641	RR 2.72 (2.60, 2.85)	34 per 100	92 per 100 (88, 96)	Very serious[1]	Serious[3]	N/A[2]	Not serious	Very low
NON-RCT: Vaccine-manager group versus enhanced usual care group (RR >1 favours vaccine-manager group)										
65+ years old										
1 (Landis 1995)	Non-randomised	1252	RR 11.08 (5.91, 20.79)	1 per 100	15 per 100 (8, 28)	Very serious[1]	Not serious	N/A[2]	Not serious	Low

1. Downgraded twice: Single study at high risk of bias.
2. Single study. Inconsistency not applicable.
3. Single study that was partially applicable to the review question. Downgraded once for indirectness.

Sensitivity analysis (removed studies at high risk of bias)

Infrastructure intervention plus another intervention aimed at healthcare providers compared to control

Table 28 GRADE table for intervention plus another intervention aimed at healthcare providers compared to control

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Feedback plus a different intervention versus control (RR >1 favours intervention)										
Feedback and bonus for good performance										
1 (Fairbrother 1999)	cRCT[3]	1510	RR 1.34 (1.20, 1.49)	41 per 100	54 per 100 (49, 61)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate
Enhanced fee for service plus feedback										

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: control	Absolute risk: intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
1 (Fairbrother 1999)	cRCT[3]	1510	RR 1.24 (1.11, 1.39)	41 per 100	50 per 100 (45, 57)	Serious[1]	Not serious	N/A[2]	Not serious	Moderate

1. Downgraded once: Single study at moderate risk of bias.
2. Single study. Inconsistency not applicable.
3. Data from Fairbrother 1999 was adjusted by the study investigators for clustering.

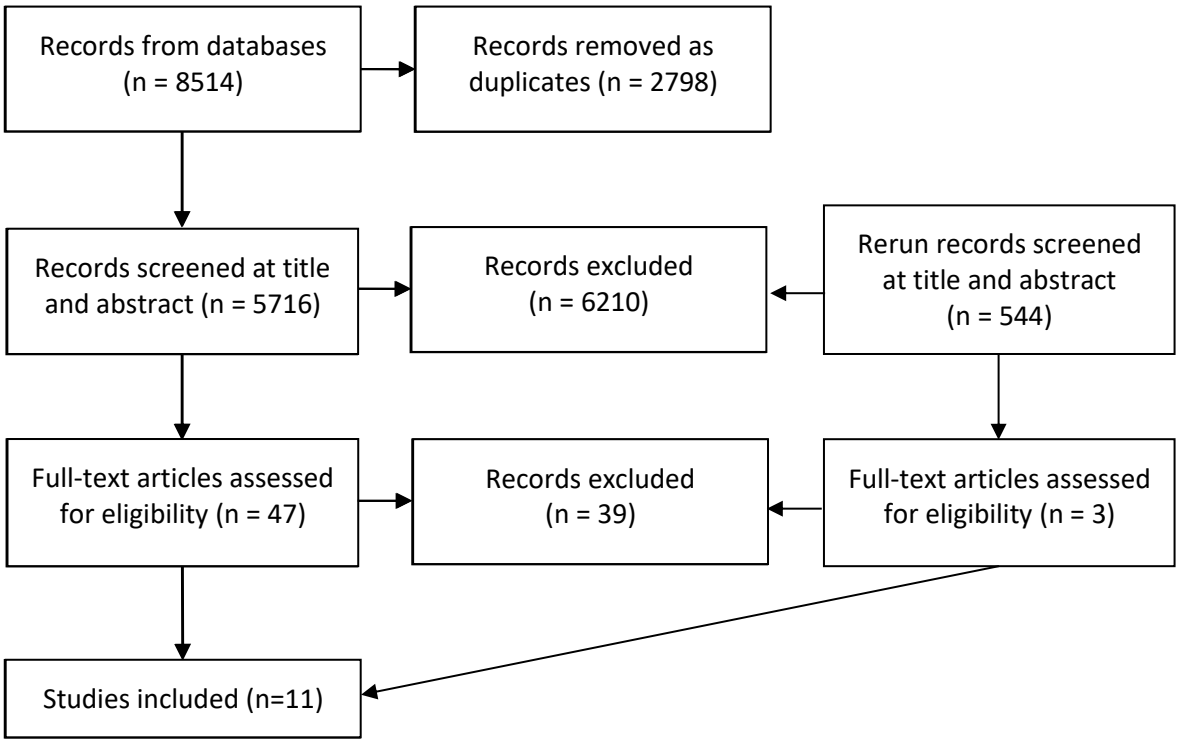
Infrastructure interventions aimed at healthcare providers compared to a different intervention

Table 29 GRADE table for interventions aimed at healthcare providers compared to a different intervention

No. of studies	Study design	Sample size	Effect size (95% CI)	Absolute risk: 2nd intervention	Absolute risk: 1st intervention (95% CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Bonus for performance versus enhanced fee for service (RR >1 favours bonus for performance)										
0-5 years old										
1 (Fairbrother 1999)	cRCT[3]	1510	RR 1.08 (0.98, 1.19)	50 per 100	55 per 100 (49, 60)	Very serious[1]	Not serious	N/A[4]	Serious[2]	Very low

1. Downgraded twice: Single study at high risk of bias. Comparisons with data from the enhanced fee for service and feedback groups were downgraded to high risk of bias due to problems with randomisation.
2. Downgraded once for imprecision: the 95% confidence interval for the effect size crossed the line of no effect.
3. Data from Fairbrother 1999 was adjusted by the study investigators for clustering.
4. Single study. Inconsistency not applicable.

Appendix G – Economic evidence study selection



Appendix H – Economic evidence tables

Appendix H1 – Evidence tables

Rafia 2016

Study	Rafia et al. (2016) An economic evaluation of contingency management for completion of hepatitis B vaccination in those on treatment for opiate dependence			
Study details	**Population & interventions**	**Costs**	**Outcomes**	**Cost effectiveness**
Economic analysis: Cost-utility analysis Study design: Decision analytic model Approach to analysis: A decision-tree to estimate the short-term (i.e. around vaccination attempts) clinical and cost impact of the vaccination strategies, followed by a Markov chain to evaluate the long-term clinical consequences and costs associated with HBV infection of a hypothetical cohort of people who inject drugs (including injectors, previous injectors and those at risk of injecting in the future as defined in the trial) undergoing treatment over the lifetime in England and Wales. Perspective: UK NHS perspective Time horizon: Lifetime Discounting: 3.5% for costs and outcomes	Population: A hypothetical cohort of people who inject drugs (including injectors, previous injectors and those at risk of injecting in the future as defined in the trial) Intervention: Hepatitis B vaccination with contingency management, assumed in the model to be a £10 voucher per appointment attendance. Two contingency management options were examined in the trial (fixed [£10 per appointment] versus escalating schedule [£5, £10 and £15 for each appointment] financial incentives). Data from the two options evaluated in the trial were pooled in	Cost difference: £21.86 (£25.13, 2021 GBP) Currency and cost year: GBP, 2013 Costs included: Direct medical costs only. Staff costs, equipment costs, vaccine costs, contingency management voucher cost, cost associated with management of hepatitis B infection. The cost of delivering vaccination was estimated to be £156.73 per participant receiving the intervention and £78.36 per participant under treatment as usual. Disease management costs over the lifetime were reduced in participants	QALY difference: 0.0032	Incremental analysis: £6,831.25 per QALY gained (£7,853.93, 2021 GBP) Analysis of uncertainty: The economic analysis was most sensitive to the time horizon, the rate of disease becoming chronic following HBV exposure, the duration individuals remain at increased risk of HBV infection (i.e. remain PWID), the incidence rate for HBV, discount rates for both costs and benefits and the cost associated with training/supervision. Under the base-case assumptions, the incidence of HBV in PWID needs to be greater than 1.2% per year for the ICER to fall below a cost-effectiveness threshold of £20 000 per QALY gained. The incidence rate in the base-case was 2.16% based on results estimated from the Unlinked Anonymous Monitoring Survey.

	the economic model in the absence of differences. Comparator: Hepatitis B vaccination without contingency management.	receiving the intervention.		The use of contingency management has an 88.51% and 97.60% probability of being considered cost-effective at willingness to pay thresholds of £20,000 and £30,000 per quality-adjusted life years gained, respectively, under the base-case assumptions.

Data sources

Outcomes: The primary outcome in the Weaver trial was vaccination completion within 28 days. Attendance rates were used in the model, and to reflect clinical practice, delayed attendance was also included.
The effectiveness associated with the receipt of one, two and three doses was obtained from the literature, as data were not collected routinely in the trial. In the economic model, it was assumed that participants receiving one and three vaccine doses had a seroprotection of 15 and 76.4% respectively, averaging these for individuals receiving two doses. It was assumed that seroprotection was conferred after the last vaccine dose, that immunity is life-long and that the last dose was within 3 months from the first.
Quality of life: Health-related quality of life scores were assigned to each of the modelled health states based on trial estimates or published literature. The baseline health utility for uninfected PWID and ex-PWID was estimated as 0.57 ± 0.34 (range = –0.43 to 1.00) based on the mean (SD) EQ-5D score in trial subjects. The decrements in quality of life for patients with active chronic hepatitis B, inactive chronic hepatitis B, compensated cirrhosis, decompensated cirrhosis, hepatocellular carcinoma, and post-liver transplant was taken from Ong et al. in non-PWID.
Costs: Only direct medical costs are included, and costs are discounted at 3.5% as per the NICE recommendation. Staff, equipment, and supervision costs were calculated from the trial, based on data collected in 10 clinics. The costs estimated include adjustment for staff time associated with non-attendance. The cost of training staff for contingency management was excluded. Direct medical costs associated with the management of HBV infection are taken from the literature and assumptions when appropriate.

Comments

Source of funding: Research funded by the National Institute for Health Research (NIHR) under its Programme Grants for Applied Research Programme (Grant Reference no. RP-PG-0707-10 149).

Overall applicability: Partially applicable

At the time of the study, hepatitis B was not a routine vaccination in the UK.

Overall quality: Minor limitations

Staff training costs were excluded in the base-case however this had a minimal impact in sensitivity analysis. It was not stated in the paper which distributions were used for non-cost parameters in the probabilistic analysis, so it is unclear whether this was performed appropriately.

Appendix H2 – Study quality tables

Rafia 2016

Study Identification: Rafia 2016, An economic evaluation of contingency management for completion of hepatitis B vaccination in those on treatment for opiate dependence.		
Guidance topic: Vaccines in the general population		**Question no: 2**
Checklist completed by: Hannah Lomax		
Section 1: Applicability (relevance to specific review questions and the NICE reference case as described in section 7.5) This checklist should be used first to filter out irrelevant studies.	**Yes/partly/no/unclear/NA**	**Comments**
1.1 Is the study population appropriate for the review question?	Yes	The study population is included in the population for the review question (people who inject drugs). However, this is only a small subset of the overall population covered by the guideline
1.2 Are the interventions appropriate for the review question?	Yes	Contingency management (financial incentives) vs no contingency management
1.3 Is the system in which the study was conducted sufficiently similar to the current UK context?	No	Based on UK RCT, with the model assuming a population in England and Wales This study was done before Hep B vaccination was routine in the UK - the comparison is only in the high risk group
1.4 Is the perspective for costs appropriate for the review question?	Partly	UK NHS perspective - only direct medical costs are considered (the cost of staff training to implement the contingency management intervention was excluded)
1.5 Is the perspective for outcomes appropriate for the review question?	Yes	
1.6 Are all future costs and outcomes discounted appropriately?	Yes	3.5% as per NICE recommendation
1.7 Are QALYs, derived using NICE's preferred methods, or an appropriate social care-related equivalent used as an outcome? If	Yes	EQ-5D scores from the trial were used to inform utility of uninfected patients, and

Study Identification: Rafia 2016, An economic evaluation of contingency management for completion of hepatitis B vaccination in those on treatment for opiate dependence.		
not, describe rationale and outcomes used in line with analytical perspectives taken (item 1.5 above).		utility decrements were taken from the literature (Ong et al.)
1.8 Overall judgement: **Partially applicable** There is no need to use section 2 of the checklist if the study is considered 'not applicable'		
Section 2: Study limitations (the level of methodological quality) This checklist should be used once it has been decided that the study is sufficiently applicable to the context of the guideline	**Yes/partly/no/unclear/NA**	**Comments**
2.1 Does the model structure adequately reflect the nature of the topic under evaluation?	Yes	Decision tree for vaccination status followed by Markov for subsequent disease progression. The model did not consider secondary infections which may have been useful to capture
2.2 Is the time horizon sufficiently long to reflect all important differences in costs and outcomes?	Yes	Lifetime
2.3 Are all important and relevant outcomes included?	Yes	Adverse events were not captured - since these are very rare this was deemed acceptable.
2.4 Are the estimates of baseline outcomes from the best available source?	Yes	From the RCT described by Weaver (2014)
2.5 Are the estimates of relative intervention effects from the best available source?	Yes	From the RCT described by Weaver (2014)
2.6 Are all important and relevant costs included?	Partly	Cost of staff training was excluded from the base-case and only had a very small impact in sensitivity analyses
2.7 Are the estimates of resource use from the best available source?	Partly	Not from an SLR but informed using the trial
2.8 Are the unit costs of resources from the best available source?	Yes	NHS reference costs and similar
2.9 Is an appropriate incremental analysis presented or can it be calculated from the data?	Yes	
2.10 Are all important parameters whose values are uncertain subjected to appropriate sensitivity analysis?	Partly	Univariate and probabilistic analyses were done. The supplementary documentation

Study Identification: Rafia 2016, An economic evaluation of contingency management for completion of hepatitis B vaccination in those on treatment for opiate dependence.		
		indicates that the costs were varied in a gamma distribution in the probabilistic analysis, but it is unclear whether other parameters were varied in appropriate distributions.
2.11 Has no potential financial conflict of interest been declared?	Yes	Interests declared but no conflicts
2.12 Overall assessment: **Minor limitations**		

1

Appendix I – Health economic model

Original health economic modelling was not prioritised for this review question.

1 Appendix J – Excluded studies

2 Clinical studies

3 Excluded from the original search

Study	Reason for exclusion
Abdullahi, L.H., Kagina, B.M., Ndze, V.N. et al. (2020) Improving vaccination uptake among adolescents. Cochrane Database of Systematic Reviews 2020(1): cd011895	- Systematic review used as source of primary studies
Abuelenen, T., Khalil, S., Simoneit, E. et al. (2020) Prevent and Protect: A Vaccination Initiative for Uninsured Patients at a Student-Run Free Clinic. Journal of community health	- The intervention is a free vaccine- not in scope *Also, the comparator is the US national vaccine uptake.*
Achat, H; McIntyre, P; Burgess, M (1999) Health care incentives in immunisation. Australian and New Zealand journal of public health 23(3): 285-8	- Systematic review used as source of primary studies
Acosta, J., Benages, C., Diaz, M.A. et al. (2016) Preventing pertussis in the early infant: Development and results of a prenatal vaccination program. Acta Medica International 3(2): 78-81	- Does not contain an outcome of relevance to this review *This study looks at infants who have had whooping cough and compares the outcomes of vaccinated vs unvaccinated participants.*
Adams, Jean, Bateman, Belinda, Becker, Frauke et al. (2015) Effectiveness and acceptability of parental financial incentives and quasi-mandatory schemes for increasing uptake of vaccinations in preschool children: systematic review, qualitative study and discrete choice experiment. Health technology assessment (Winchester, England) 19(94): 1-176	- Systematic review used as source of primary studies
Adams, Jean, McNaughton, Rebekah J, Wigham, Sarah et al. (2016) Acceptability of Parental Financial Incentives and Quasi-Mandatory Interventions for Preschool Vaccinations: Triangulation of Findings from Three Linked Studies. PloS one 11(6): e0156843	- Not a relevant study design
Adjei Boakye, Eric, Tobo, Betelihem B, Osazuwa-Peters, Nosayaba et al. (2017) A Comparison of Parent- and Provider-Reported Human Papillomavirus Vaccination of Adolescents. American journal of preventive medicine 52(6): 742-752	- Study does not contain an intervention aimed at increasing vaccine uptake

Study	Reason for exclusion
	This study looks at reporting vaccine uptake in terms of provider records vs parental recall.
Afzal, Muhammad, Yaqub, Asma, Khalid, Sobia et al. (2017) An effective and doable interventional strategy to enhance vaccination coverage - are we ready to change?. JPMA. The Journal of the Pakistan Medical Association 67(11): 1719-1722	- Study took place in a non-OECD country
Albert, S.M., Nowalk, M.P., Yonas, M.A. et al. (2012) Standing orders for influenza and pneumococcal polysaccharide vaccination: correlates identified in a national survey of U.S. Primary care physicians. BMC family practice 13: 22	- Does not contain an outcome of relevance to this review
Alemi, F, Alemagno, SA, Goldhagen, J et al. (1996) Computer reminders improve on-time immunization rates. Medical care 34(10suppl): OS45-51	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Amirian, I, Huston, S, Ha, D et al. (2017) Results of immunization delivery enhancement intervention on pneumococcal and herpes zoster immunization planning in alabama and california community pharmacies. Journal of the american pharmacists association 57(3)	- Conference abstract
Andrews, R.M. (2005) Assessment of vaccine coverage following the introduction of a publicly funded pneumococcal vaccine program for the elderly in Victoria, Australia. Vaccine 23(21): 2756-2761	- Not a relevant study design *This is a survey. Furthermore, there is no intervention to increase uptake beyond making a vaccine freely available.*
Andrews, Ross M, Skull, Susan A, Byrnes, Graham B et al. (2005) Influenza and pneumococcal vaccine coverage among a random sample of hospitalised persons aged 65 years or more, Victoria. Communicable diseases intelligence quarterly report 29(3): 283-8	- The intervention is a free vaccine- not in scope
Anonymous (1979) AAP immunization schedules. IMJ. Illinois medical journal 155(5): 310-1	- Full text paper or book article is unavailable *This is probably the 1979 edition of the immunisation schedule published by the*

Study	Reason for exclusion
	American Academy of Pediatrics
Anonymous (2013) Nursing interventions help protect older adults. Nursing 43(4): 26	- Not a review of published literature *Brief commentary about a review article.*
Anonymous. (2005) Automated standing orders to nurses increase influenza and pneumococcal vaccination rates among inpatients compared with reminders to physicians. Evidence-Based Healthcare and Public Health 9(3): 211-212	- Duplicate reference *This is a summary of Dexter 2004*
Arslan I, Beyazova U, Aksakal N et al. (2012) New opportunity for vaccinating older people: well-child clinic visits. Pediatrics international : official journal of the Japan Pediatric Society 54(1): 45-51	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Ashton-Key M and Jorge E (2003) Does providing social services with information and advice on immunisation status of "looked after children" improve uptake?. Archives of disease in childhood 88(4): 299-301	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Atkins K, van Hoek AJ, Watson C et al. Seasonal influenza vaccination delivery through community pharmacists in England: evaluation of the London pilot. BMJ open 6(2): e009739	- Data not reported in an extractable format *This is a before-and-after study but no patient numbers are provided for before 2013/2014 when the intervention was introduced. Therefore, the data is not in an extractable format.*
Atkinson, K.M., Wilson, K., Murphy, M.S.Q. et al. (2019) Effectiveness of digital technologies at improving vaccine uptake and series completion - A systematic review and meta-analysis of randomized controlled trials. Vaccine 37(23): 3050-3060	- Systematic review used as source of primary studies

Study	Reason for exclusion
Au, L; Tso, A; Chin, K (1997) Asian-American adolescent immigrants: the New York City schools experience. The Journal of school health 67(7): 277-9	- Vaccine on UK routine schedule but wrong context for administration *In the UK, HepB vaccine is given to 0-1 year olds, not 7-13 year olds*
Averhoff, F., Linton, L., Peddecord, K.M. et al. (2004) A middle school immunization law rapidly and substantially increases immunization coverage among adolescents. American Journal of Public Health 94(6): 978-984	- Vaccine on UK routine schedule but wrong context for administration *The intervention is for HepB and MMR. In the UK, these are relevant for 0-4 years. However, the study looks at interventions specific to 10-12 year olds at school.*
Bacci, Jennifer L, Hansen, Ryan, Ree, Christina et al. (2019) The effects of vaccination forecasts and value-based payment on adult immunizations by community pharmacists. Vaccine 37(1): 152-159	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Bach, A.T., Kang, A.Y., Lewis, J. et al. (2019) Addressing common barriers in adult immunizations: a review of interventions. Expert Review of Vaccines 18(11): 1167-1185	- Systematic review used as source of primary studies
Bakare, Mobolaji, Shrivastava, Rakesh, Jeevanantham, Vinodh et al. (2007) Impact of two different models on influenza and pneumococcal vaccination in hospitalized patients. Southern medical journal 100(2): 140-4	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Balzarini, F., Frascella, B., Oradini-Alacreu, A. et al. (2020) Does the use of personal electronic health records increase vaccine uptake? A systematic review. Vaccine 38(38): 5966-5978	- Systematic review used as source of primary studies
Bangure, Donewell, Chirundu, Daniel, Gombe, Notion et al. (2015) Effectiveness of short message services reminder on childhood immunization programme in Kadoma, Zimbabwe - a randomized controlled trial, 2013. BMC public health 15: 137	- Study took place in a non-OECD country

Study	Reason for exclusion
Bardenheier, Barbara, Shefer, Abigail, Tiggle, Ronald et al. (2005) Nursing home resident and facility characteristics associated with pneumococcal vaccination: national nursing home survey, 1995-1999. Journal of the American Geriatrics Society 53(9): 1543-51	- The study did not report any of the outcomes specified in the protocol
Baroy, Justin, Chung, Danny, Frisch, Ryan et al. (2016) The impact of pharmacist immunization programs on adult immunization rates: A systematic review and meta-analysis. Journal of the American Pharmacists Association : JAPhA 56(4): 418-26	- Systematic review used as source of primary studies
Bassani, Diego G, Arora, Paul, Wazny, Kerri et al. (2013) Financial incentives and coverage of child health interventions: a systematic review and meta-analysis. BMC public health 13suppl3: 30	- Systematic review of non-OECD countries
Baumann, A., Andersen, B., Ostergaard, L. et al. (2019) Sense & sensibility: Decision-making and sources of information in mothers who decline HPV vaccination of their adolescent daughters. Vaccine: X 2: 100020	- Not a relevant study design
Baxter D (2013) Approaches to the vaccination of pregnant women: experience from Stockport, UK, with prenatal influenza. Human vaccines & immunotherapeutics 9(6): 1360-1363	- Data not reported in an extractable format *The number of participants in each arm was not provided.*
Becker DM, Gomez EB, Kaiser DL et al. (1989) Improving preventive care at a medical clinic: how can the patient help?. American journal of preventive medicine 5(6): 353-359	- Study published before 1990 date limit set in review protocol
Bedford, H. (2014) Randomised controlled trial: Pro-vaccine messages may be counterproductive among vaccine-hesitant parents. Evidence-Based Medicine 19(6): 219	- Does not contain an outcome of relevance to this review *This study measures intention, not uptake.*
Bedwick, Brian W; Garofoli, Gretchen K; Elswick, Betsy M (2017) Assessment of targeted automated messages on herpes zoster immunization numbers in an independent community pharmacy. Journal of the American Pharmacists Association : JAPhA 57(3s): 293-s297e1	- Does not contain an outcome of relevance to this review

Study	Reason for exclusion
Beggs, Ashton E, Morrical-Kline, Karie A, Wilhoite, Jessica E et al. (2013) Effect of an intervention on medical resident knowledge and adult immunization rates. Family medicine 45(2): 118-21	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Belmaker, I, Dukhan, L, Elgrici, M et al. (2006) Reduction of vaccine-preventable communicable diseases in a Bedouin population: summary of a community-based intervention programme. Lancet (London, England) 367(9515): 987-91	- Study took place in a non-OECD country
Benabbas, R., Shan, G., Akindutire, O. et al. (2019) The Effect of Pay-for-Performance Compensation Model Implementation on Vaccination Rate: A Systematic Review. Quality management in health care 28(3): 155-162	- Systematic review used as source of primary studies
Berenson, Abbey B, Rahman, Mahbubur, Hirth, Jacqueline M et al. (2015) A brief educational intervention increases providers' human papillomavirus vaccine knowledge. Human vaccines & immunotherapeutics 11(6): 1331-6	- Study does not contain an intervention aimed at increasing vaccine uptake
Berg GD, Fleegler E, vanVonno CJ et al. (2005) A matched-cohort study of health services utilization outcomes for a heart failure disease management program. Disease management : DM 8(1): 35-41	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Berg, Gregory D, Thomas, Eileen, Silverstein, Steven et al. (2004) Reducing medical service utilization by encouraging vaccines: randomized controlled trial. American journal of preventive medicine 27(4): 284-8	- Study does not contain an intervention aimed at increasing vaccine uptake *The 2 marketing pieces were identical and aimed at increasing influenza vaccine uptake - not pneumonia vaccine uptake. Pneumonia vaccine uptake was measured coincidentally.*
Betsch, Cornelia, Rossmann, Constanze, Pletz, Mathias W et al. (2018) Increasing influenza and pneumococcal vaccine uptake in the elderly: study protocol for the multi-methods prospective intervention study Vaccination60. BMC public health 18(1): 885	- Protocol for a future study
Bigham, M., Remple, V.P., Pielak, K. et al. (2006) Uptake and behavioural and attitudinal determinants of immunization in an expanded routine infant hepatitis B vaccination program in British Columbia. Canadian Journal of Public Health 97(2): 90-95	- Study does not contain an intervention aimed at increasing vaccine uptake

Study	Reason for exclusion
	The intervention is nothing more than a free vaccine.
Bitton, A., Baughman, A.W., Carlini, S. et al. (2016) Enhanced primary care and impact on quality of care in Massachusetts. American Journal of Managed Care 22(5): e169-e174	- Not a relevant study design
Bloom, H.G.; Wheeler, D.A.; Linn, J. (1999) A managed care organization's attempt to increase influenza and pneumococcal immunizations for older adults in an acute care setting. Journal of the American Geriatrics Society 47(1): 106-110	- Does not contain an outcome of relevance to this review *This study does not have a comparator*
Bloom, HG, Bloom, JS, Krasnoff, L et al. (1988) Increased utilization of influenza and pneumococcal vaccines in an elderly hospitalized population. Journal of the American Geriatrics Society 36(10): 897-901	- Study published before 1990 date limit set in review protocol
Bonafide, Katherine E and Vanable, Peter A (2015) Male human papillomavirus vaccine acceptance is enhanced by a brief intervention that emphasizes both male-specific vaccine benefits and altruistic motives. Sexually transmitted diseases 42(2): 76-80	- Does not contain an outcome of relevance to this review
Bond, L., Davie, G., Carlin, J.B. et al. (2002) Increases in vaccination coverage for children in child care, 1997 to 2000: An evaluation of the impact of government incentives and initiatives. Australian and New Zealand Journal of Public Health 26(1): 58-64	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Boom JA, Nelson CS, Kohrt AE et al. (2010) Utilizing peer academic detailing to improve childhood immunization coverage levels. Health promotion practice 11(3): 377-386	- Does not contain an outcome of relevance to this review *Study does not measure uptake. It measures "coverage" and explains this is not uptake but does not fully explain what the criteria are for adequate coverage.*

Study	Reason for exclusion
Boom, Julie A, Nelson, Cynthia S, Laufman, Larry E et al. (2007) Improvement in provider immunization knowledge and behaviors following a peer education intervention. Clinical pediatrics 46(8): 706-17	- Does not contain an outcome of relevance to this review *The data is a survey of opinions and attitudes.*
Borgiel, Alexander E M, Williams, J Ivan, Davis, David A et al. (1999) Evaluating the effectiveness of 2 educational interventions in family practice: CMAJ. Canadian Medical Association. Journal 161(8): 965-70	- Does not contain an outcome of relevance to this review *Does not measure vaccine uptake*
Bouchez, M., Ward, J.K., Bocquier, A. et al. (2021) Physicians' decision processes about the HPV vaccine: A qualitative study. Vaccine 39(3): 521-528	- Not a relevant study design *Qualitative study - considered for the qualitative review*
Brabin, Loretta, Roberts, Stephen A, Stretch, Rebecca et al. (2008) Uptake of first two doses of human papillomavirus vaccine by adolescent schoolgirls in Manchester: prospective cohort study. BMJ (Clinical research ed.) 336(7652): 1056-8	- Does not contain an outcome of relevance to this review *There is no comparator*
Brackett, Amber; Butler, Michell; Chapman, Liza (2015) Using motivational interviewing in the community pharmacy to increase adult immunization readiness: A pilot evaluation. Journal of the American Pharmacists Association : JAPhA 55(2): 182-6	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Bradshaw, C., DiFrisco, E., Schweizer, W. et al. (2020) Improving birth dose hepatitis B vaccination rates: A quality improvement intervention. Hospital Pediatrics 10(5): 430-437	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Braeckman, T., Van Herck, K., Raes, M. et al. (2011) Rotavirus vaccines in Belgium: Policy and impact. Pediatric Infectious Disease Journal 30(suppl1): 21-s24	- Does not contain an outcome of relevance to this review

Study	Reason for exclusion
Brewer, NT, Gilkey, MB, Malo, TL et al. (2018) Efficient and participatory strategies for recommending HPV vaccination: a randomized controlled trial. Pediatrics 141(1)	- Conference abstract
Brewer, NT, Hall, ME, Malo, TL et al. (2017) Announcements Versus Conversations to Improve HPV Vaccination Coverage: a Randomized Trial. Pediatrics 139(1)	- Data not reported in an extractable format *Data was given as percentages without participant numbers*
Brigham, Kathryn S, Woods, Elizabeth R, Steltz, Sarah K et al. (2012) Randomized controlled trial of an immunization recall intervention for adolescents. Pediatrics 130(3): 507-14	- Data not reported in an extractable format *The study reports combined uptake data for 3 vaccinations but chickenpox vaccination is not on the UK routine schedule.*
Brimberry, R (1988) Vaccination of high-risk patients for influenza. A comparison of telephone and mail reminder methods. The Journal of family practice 26(4): 397-400	- Study published before 1990 date limit set in review protocol - The study did not report any of the outcomes specified in the protocol *Focused on flu vaccination which is out of scope*
Brink SG (1989) Provider reminders. Changing information format to increase infant immunizations. Medical care 27(6): 648-653	- Study published before 1990 date limit set in review protocol
Briss P A, Rodewald L E, Hinman A R, Shefer A M, Strikas R A, Bernier R R, Carande-Kulis V G, Yusuf H R, Ndiaye S M, Williams S M (2000) Reviews of evidence regarding interventions to improve vaccination coverage in children, adolescents, and adults. American Journal of Preventive Medicine 18(1 Supplement): 97-140	- Review article but not a systematic review
Briss, P A, Rodewald, L E, Hinman, A R et al. (2000) Reviews of evidence regarding interventions to improve vaccination coverage in children, adolescents, and adults. The Task Force on Community	- Duplicate reference

Study	Reason for exclusion
Preventive Services. American journal of preventive medicine 18(1suppl): 97-140	
Briss, P.A., Rodewald, L.E., Hinman, A.R. et al. (2000) Reviews of evidence regarding interventions to improve vaccination coverage in children, adolescents, and adults. American Journal of Preventive Medicine 18(1suppl1): 97-140	- Duplicate reference
Britto, Maria T, Schoettker, Pamela J, Pandzik, Geralyn M et al. (2007) Improving influenza immunisation for high-risk children and adolescents. Quality & safety in health care 16(5): 363-8	- The study did not report any of the outcomes specified in the protocol
Brousseau, Nicholas, Sauvageau, Chantal, Ouakki, Manale et al. (2010) Feasibility and impact of providing feedback to vaccinating medical clinics: evaluating a public health intervention. BMC public health 10: 750	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Bryan AR; Liu Y; Kuehl PG (2013) Advocating zoster vaccination in a community pharmacy through use of personal selling. Journal of the American Pharmacists Association : JAPhA 53(1): 70-77	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Burka, A.T., Fann, J.P., Lamb, K.D. et al. (2019) Evaluation of a novel discharge reminder tool on pneumococcal vaccination in hospitalized elderly veterans. JACCP Journal of the American College of Clinical Pharmacy 2(5): 462-467	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Burns, Ilene Timko; Zimmerman, Richard Kent; Santibanez, Tammy A (2002) Effectiveness of chart prompt about immunizations in an urban health center. The Journal of family practice 51(12): 1018	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Burson, Randall C, Buttenheim, Alison M, Armstrong, Allison et al. (2016) Community pharmacies as sites of adult vaccination: A systematic review. Human vaccines & immunotherapeutics 12(12): 3146-3159	- Systematic review used as source of primary studies
Calihan, Jessica B, MD, MS, Tomaszewski, Kathy, RN, Wheeler, Noah, MPH et al. (2020) USING REPRODUCTIVE HEALTH VISITS	- Conference abstract

Study	Reason for exclusion
TO ENGAGE ADOLESCENT AND YOUNG ADULT WOMEN IN PRIMARY CARE. Journal of Adolescent Health 66(2s)	
Calo, William A, Gilkey, Melissa B, Leeman, Jennifer et al. (2019) Coaching primary care clinics for HPV vaccination quality improvement: Comparing in-person and webinar implementation. Translational behavioral medicine 9(1): 23-31	- Does not contain an outcome of relevance to this review
Cardozo LJ, Steinberg J, Lepczyk MB et al. (1998) Delivery of preventive healthcare to older African-American patients: a performance comparison from two practice models. The American journal of managed care 4(6): 809-816	- Data not reported in an extractable format *Data in graph form with no error bars (no SD, SE or CI provided).*
Carney, Patricia A, Hatch, Brigit, Stock, Isabel et al. (2019) A stepped-wedge cluster randomized trial designed to improve completion of HPV vaccine series and reduce missed opportunities to vaccinate in rural primary care practices. Implementation science : IS 14(1): 30	- Protocol for a future study
Carolan, Kate, Verran, Joanna, Crossley, Matthew et al. (2018) Impact of educational interventions on adolescent attitudes and knowledge regarding vaccination: A pilot study. PloS one 13(1): e0190984	- Does not contain an outcome of relevance to this review
Carter, W B; Beach, L R; Inui, T S (1986) The flu shot study: using multiattribute utility theory to design a vaccination intervention. Organizational behavior and human decision processes 38(3): 378-91	- Study published before 1990 date limit set in review protocol - The study did not report any of the outcomes specified in the protocol
Caskey, R; Weiner, S; Gerber, B (2011) Exam-room based education to influence vaccination behavior among veteran patients in a primary care setting. Journal of general internal medicine 26: S271	- Conference abstract
Cassidy B, Braxter B, Charron-Prochownik D et al. (2014) A quality improvement initiative to increase HPV vaccine rates using an educational and reminder strategy with parents of preteen girls. Journal of pediatric health care : official publication of National Association of Pediatric Nurse Associates & Practitioners 28(2): 155-164	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Cataldi, J.R., Habesland, M., Anderson-Mellies, A. et al. (2020) The potential population-based impact of an HPV vaccination intervention in Colorado. Cancer Medicine 9(4): 1553-1561	- Does not contain an outcome of relevance to this review *The paper is a follow up study looking at implementing a relevant intervention in Colorado rather then the effectiveness of the intervention itself.*
Cates, Joan R, Diehl, Sandra J, Crandell, Jamie L et al. (2014) Intervention effects from a social marketing campaign to promote HPV vaccination in preteen boys. Vaccine 32(33): 4171-8	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Chamberlain, Allison T, Seib, Katherine, Ault, Kevin A et al. (2016) Impact of a multi-component antenatal vaccine promotion package on improving knowledge, attitudes and beliefs about influenza and Tdap vaccination during pregnancy. Human vaccines & immunotherapeutics 12(8): 2017-2024	- Does not contain an outcome of relevance to this review
Chan, Sophia S C, Leung, Doris Y P, Leung, Angela Y M et al. (2015) A nurse-delivered brief health education intervention to improve pneumococcal vaccination rate among older patients with chronic diseases: a cluster randomized controlled trial. International journal of nursing studies 52(1): 317-24	- Study took place in a non-OECD country
Chau, Janita Pak Chun, Lo, Suzanne Hoi Shan, Choi, Kai Chow et al. (2020) Effects of a multidisciplinary team-led school-based human papillomavirus vaccination health-promotion programme on improving vaccine acceptance and uptake among female adolescents: A cluster randomized controlled trial. Medicine 99(37): e22072	- Study took place in a non-OECD country
Chien AT; Li Z; Rosenthal MB (2010) Improving timely childhood immunizations through pay for performance in Medicaid-managed care. Health services research 45(6 Pt 2): 1934-1947	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This study was an interrupted time series.*
Closser, Svea, Rosenthal, Anat, Maes, Kenneth et al. (2016) The Global Context of Vaccine Refusal: Insights from a Systematic	- Study took place in a non-OECD country

Study	Reason for exclusion
Comparative Ethnography of the Global Polio Eradication Initiative. Medical Anthropology Quarterly 30(3): 321	
Coley, K.C., Gessler, C., McGivney, M. et al. (2020) Increasing adult vaccinations at a regional supermarket chain pharmacy: A multi-site demonstration project. Vaccine 38(24): 4044-4049	- Data not reported in an extractable format *The number of participants considered for vaccination was not provided. They only reported the number of vaccinations given.*
Collins, Brian K, Morrow, Helen E, Ramirez, Jennifer M et al. (2006) Childhood immunization coverage in US states: the impact of state policy interventions and programmatic support. Journal of health & social policy 22(1): 77-92	- Not a review of published literature *Study uses a survey to review the impact of interventions.*
Connors, John T; Slotwinski, Kate L; Hodges, Eric A (2017) Provider-parent Communication When Discussing Vaccines: A Systematic Review. Journal of pediatric nursing 33: 10-15	- Systematic review that does not include the outcomes stated in the protocol
Cooper Robbins, Spring Chenoa; Ward, Kirsten; Skinner, S Rachel (2011) School-based vaccination: a systematic review of process evaluations. Vaccine 29(52): 9588-99	- Systematic review used as source of primary studies
Cooper, S.C., Davies, C., McBride, K. et al. (2016) Development of a human papillomavirus vaccination intervention for Australian adolescents. Health Education Journal 75(5): 610-620	- The study did not report any of the outcomes specified in the protocol
Cory, L., Cha, B., Ellenberg, S. et al. (2019) Effects of Educational Interventions on Human Papillomavirus Vaccine Acceptability: A Randomized Controlled Trial. Obstetrics and Gynecology 134(2): 376-384	- Study participants are the wrong age group *The mean age of the participants was 24 years (SD 4). For HPV vaccination, the protocol is for participants aged 11-18 years.*
Costantino, C., Restivo, V., Ventura, G. et al. (2018) Increased vaccination coverage among adolescents and young adults in the	- Education non-RCT. Excluded because there

Study	Reason for exclusion
district of Palermo as a result of a public health strategy to counteract an 'epidemic panic'. International Journal of Environmental Research and Public Health 15(5): 1014	was sufficient RCT evidence for this review *This was a before-and-after information/education study.*
Costantino, Claudio, Caracci, Francesca, Brandi, Mariarosa et al. (2020) Determinants of vaccine hesitancy and effectiveness of vaccination counseling interventions among a sample of the general population in Palermo, Italy. Human vaccines & immunotherapeutics: 1-7	- Does not contain an outcome of relevance to this review
Cox, Dena S, Cox, Anthony D, Sturm, Lynne et al. (2010) Behavioral interventions to increase HPV vaccination acceptability among mothers of young girls. Health psychology : official journal of the Division of Health Psychology, American Psychological Association 29(1): 29-39	- Does not contain an outcome of relevance to this review *This study looks at vaccination intention, not uptake.*
Coyle, Christina M and Currie, Brian P (2004) Improving the rates of inpatient pneumococcal vaccination: impact of standing orders versus computerized reminders to physicians. Infection control and hospital epidemiology 25(11): 904-7	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Crawford, N.W., Barfield, C., Hunt, R.W. et al. (2014) Improving preterm infants' immunisation status: A follow-up audit. Journal of Paediatrics and Child Health 50(4): 314-318	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Crocker-Buque, Tim; Edelstein, Michael; Mounier-Jack, Sandra (2017) Interventions to reduce inequalities in vaccine uptake in children and adolescents aged <19 years: a systematic review. Journal of epidemiology and community health 71(1): 87-97	- Systematic review used as source of primary studies
Crocker-Buque, Tim and Mounier-Jack, Sandra (2018) Vaccination in England: a review of why business as usual is not enough to maintain coverage. BMC public health 18(1): 1351	- Systematic review used as source of primary studies
Cuff, R.D., Buchanan, T., Pelkofski, E. et al. (2016) Rates of human papillomavirus vaccine uptake amongst girls five years after introduction of statewide mandate in Virginia Presented as a podium presentation at the Annual Meeting of the South Atlantic Association of Obstetricians and Gynecologists, Charleston, South Carolina,	- Conference abstract

Study	Reason for exclusion
January 30-February 2, 2016. American Journal of Obstetrics and Gynecology 214(6): 752	
Cuff, Ryan D, Buchanan, Tommy, Pelkofski, Elizabeth et al. (2016) Rates of human papillomavirus vaccine uptake amongst girls five years after introduction of statewide mandate in Virginia. American journal of obstetrics and gynecology 214(6): 752e1-6	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Curran, Eileen A; Bednarczyk, Robert A; Omer, Saad B (2013) Evaluation of the frequency of immunization information system use for public health research. Human vaccines & immunotherapeutics 9(6): 1346-50	- Systematic review that does not include the outcomes stated in the protocol *Review evaluating the use of an information system in research*
Cutrona, S.L., Golden, J.G., Goff, S.L. et al. (2018) Improving Rates of Outpatient Influenza Vaccination Through EHR Portal Messages and Interactive Automated Calls: A Randomized Controlled Trial. Journal of General Internal Medicine 33(5): 659-667	- Study participants are the wrong age group *59% of the participants were younger than 50 years. This study has pneumococcal vaccine uptake data but this vaccine is routinely given to people aged 65 years and older in the UK.*
Czajka, H., Lauterbach, R., Pawlik, D. et al. (2017) Implementation of mandatory vaccinations against diphtheria, tetanus and pertussis in preterm infants as part of the Polish Immunization Programme. Pediatria Polska 92(5): 485-493	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study about mandatory vaccinations. The 2 subgroups of babies in the intervention arm all received the same intervention.*

Study	Reason for exclusion
Daku, Mark; Raub, Amy; Heymann, Jody (2012) Maternal leave policies and vaccination coverage: a global analysis. Social science & medicine (1982) 74(2): 120-4	- Not a relevant study design *This is a global survey that looks at correlations.*
Daley, Matthew F, MD, Narwaney, Komal J, MPH, PhD, Shoup, Jo Ann, PhD et al. (2018) Addressing Parents' Vaccine Concerns: A Randomized Trial of a Social Media Intervention. American Journal of Preventive Medicine 55(1): 44	- Does not contain an outcome of relevance to this review
Das, J.K., Salam, R.A., Arshad, A. et al. (2016) Systematic Review and Meta-Analysis of Interventions to Improve Access and Coverage of Adolescent Immunizations. Journal of Adolescent Health 59(2supplement): 40-s48	- Systematic review used as source of primary studies
Davies, C., Skinner, S.R., Stoney, T. et al. (2017) 'Is it like one of those infectious kind of things?' The importance of educating young people about HPV and HPV vaccination at school. Sex Education 17(3): 256-275	- Does not contain an outcome of relevance to this review
Davis TC, Fredrickson DD, Arnold C et al. (1998) A polio immunization pamphlet with increased appeal and simplified language does not improve comprehension to an acceptable level. Patient education and counseling 33(1): 25-37	- The study did not report any of the outcomes specified in the protocol
de Oliveira Bressane Lima, P., van Lier, A., de Melker, H. et al. (2020) MenACWY vaccination campaign for adolescents in the Netherlands: Uptake and its determinants. Vaccine 38(34): 5516-5524	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
deHart, M.P., Salinas, S.K., Barnette Jr., L.J. et al. (2005) Project Protect: Pneumococcal vaccination in Washington State nursing homes. Journal of the American Medical Directors Association 6(2): 91-96	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review
Dempsey AF, Maertens J, Beaty B et al. (2015) Characteristics of users of a tailored, interactive website for parents and its impact on adolescent vaccination attitudes and uptake. BMC research notes 8: 739	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Dempsey AF, Zimet GD, Davis RL et al. (2006) Factors that are associated with parental acceptance of human papillomavirus vaccines: a randomized intervention study of written information about HPV. Pediatrics 117(5): 1486-1493	- The study did not report any of the outcomes specified in the protocol
Dempsey Amanda, F, Pyrznawoski, Jennifer, Lockhart, Steven et al. (2018) Effect of a Health Care Professional Communication Training Intervention on Adolescent Human Papillomavirus Vaccination: a Cluster Randomized Clinical Trial. 172	- Duplicate reference *Dempsey 2015 was included in this evidence review.*
Dempsey, A.F., Pyrzanowski, J., Campbell, J. et al. (2020) Cost and reimbursement of providing routine vaccines in outpatient obstetrician/gynecologist settings. American Journal of Obstetrics and Gynecology 223(4): 562	- Duplicate reference *This is an economic analysis of O'Leary 2019: "Effectiveness of a multimodal intervention to increase vaccination in obstetrics/gynecology settings"*
Dempsey, A.F. and Zimet, G.D. (2015) Interventions to Improve Adolescent Vaccination: What May Work and What Still Needs to Be Tested. Vaccine 33(supplement4): d106-d113	- Review article but not a systematic review
Dempsey, Amanda F and Zimet, Gregory D (2015) Interventions to Improve Adolescent Vaccination: What May Work and What Still Needs to Be Tested. American journal of preventive medicine 49(6suppl4): 445-54	- Duplicate reference *Article published in a different journal concurrently with identical text.*
Desai, Sonali P, Lu, Bing, Szent-Gyorgyi, Lara E et al. (2013) Increasing pneumococcal vaccination for immunosuppressed patients: a cluster quality improvement trial. Arthritis and rheumatism 65(1): 39-47	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Deshmukh, Uma, Oliveira, Carlos R, Griggs, Susan et al. (2018) Impact of a clinical interventions bundle on uptake of HPV vaccine at an OB/GYN clinic. Vaccine 36(25): 3599-3605	- Vaccine on UK routine schedule but wrong context for administration *The mean age of the women receiving the HPV vaccine was 22 years.*

Study	Reason for exclusion
Dexheimer, Judith W, Jones, Ian, Waitman, Russ et al. (2006) Prospective evaluation of a closed-loop, computerized reminder system for pneumococcal vaccination in the emergency department. AMIA ... Annual Symposium proceedings. AMIA Symposium: 910	- Conference abstract
Dexheimer, Judith W, Talbot, Thomas R 3rd, Ye, Fei et al. (2011) A computerized pneumococcal vaccination reminder system in the adult emergency department. Vaccine 29(40): 7035-41	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Dexheimer, Judith W, Talbot, Thomas R, Ye, Fei et al. (2008) Implementing a computerized pneumococcal vaccination reminder system in an emergency department: a prospective study. AMIA ... Annual Symposium proceedings. AMIA Symposium: 867	- Conference abstract
Dexter LJ, Teare MD, Dexter M et al. (2012) Strategies to increase influenza vaccination rates: outcomes of a nationwide cross-sectional survey of UK general practice. BMJ open 2(3)	- Data not reported in an extractable format *The number of participants in each arm was not provided. The study mentions supplementary tables but they are not provided on the journal's website.*
Dexter, P R, Perkins, S, Overhage, J M et al. (2001) A computerized reminder system to increase the use of preventive care for hospitalized patients. The New England journal of medicine 345(13): 965-70	- Data not reported in an extractable format *Pneumonococcal vaccine uptake data reported per hospitalisation and not per person.*
Dini, E F, Chaney, M, Moolenaar, R L et al. (1996) Information as intervention: how Georgia used vaccination coverage data to double public sector vaccination coverage in seven years. Journal of public health management and practice : JPHMP 2(1): 45-9	- Review article but not a systematic review
Dini; Linkins; Sigafoos (2000) The impact of computer-generated messages on childhood immunization coverage(2)(2). American journal of preventive medicine 19(1): 68-70	- Duplicate reference

Study	Reason for exclusion
Dini; Linkins; Sigafoos (2000) The impact of computer-generated messages on childhood immunization coverage(2)(2). American journal of preventive medicine 19(1): 68-70	- Duplicate reference
Dixon, B, Downs, S, Zhang, Z et al. (2016) A mhealth intervention trial to improve HPV vaccination rates in urban primary care clinics. Sexually transmitted diseases 43(10): S199	- Conference abstract
Dixon, Brian E, Kasting, Monica L, Wilson, Shannon et al. (2017) Health care providers' perceptions of use and influence of clinical decision support reminders: qualitative study following a randomized trial to improve HPV vaccination rates. BMC medical informatics and decision making 17(1): 119	- Does not contain an outcome of relevance to this review *The quanitative study is Zimet 2018, which is detailed elsewhere. Dixon 2017 has qualitative findings.*
Djibuti, M., Gotsadze, G., Zoidze, A. et al. (2009) The role of supportive supervision on immunization program outcome - A randomized field trial from Georgia. BMC International Health and Human Rights 9(suppl1): 11	- Study took place in a non-OECD country
Dona, Daniele, Masiero, Susanna, Brisotto, Sara et al. (2018) Special Immunization Service: A 14-year experience in Italy. PloS one 13(4): e0195881	- Not a relevant study design
Donahue K, Hendrix K, Sturm L et al. (2018) Provider Communication and Mothers' Willingness to Vaccinate Against Human Papillomavirus and Influenza: A Randomized Health Messaging Trial. Academic pediatrics 18(2): 145-153	- The study did not report any of the outcomes specified in the protocol
Donnelly, Amber (2008) HPV vaccination: Parental perspectives in Omaha, Nebraska. Dissertation Abstracts International: Section B: The Sciences and Engineering 69(5b): 2941	- Full text paper or book article is unavailable *Dissertation abstract*
Dorell, Christina G, Yankey, David, Santibanez, Tammy A et al. (2011) Human papillomavirus vaccination series initiation and completion, 2008-2009. Pediatrics 128(5): 830-9	- Not a relevant study design *Survey that looks at correlations/risk factors.*

Study	Reason for exclusion
Dubowitz H., Feigelman S. LW&KJ (2009) Pediatric primary care to help prevent child maltreatment: the Safe Environment for Every Kid (SEEK) model. Pediatrics: 858-864	- Study does not contain an intervention aimed at increasing vaccine uptake *This study is about preventing child mistreatment via social work etc. There is no mention of interventions to increase vaccination uptake in the methods section.*
Dumo P, Dougherty J SM (2002) Impact of clinical pharmacists on vaccination rates in medicine, surgery, and infectious disease services: a randomized, controlled trial. Pharmacotherapy 10: 1347–8	- Conference abstract
Dylag, Andrew M and Shah, Shetal I (2008) Administration of tetanus, diphtheria, and acellular pertussis vaccine to parents of high-risk infants in the neonatal intensive care unit. Pediatrics 122(3): e550-5	- Does not contain an outcome of relevance to this review *This study does not have a comparator.*
Eason E, Naus M, Sciberras J et al. (2001) Evaluation of an institution-based protocol for postpartum rubella vaccination. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 165(10): 1321-1323	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Eckrode, Carl; Church, Nancy; English, Woodruff J 3rd (2007) Implementation and evaluation of a nursing assessment/standing orders-based inpatient pneumococcal vaccination program. American journal of infection control 35(8): 508-15	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Eid, Deeb D; Meagher, Rebecca C; Lengel, Aaron J (2015) The Impact of Pharmacist Interventions on Herpes Zoster Vaccination Rates. The Consultant pharmacist : the journal of the American Society of Consultant Pharmacists 30(8): 459-62	- Review article but not a systematic review
Ellerbeck, Edward F, Totten, Bonnie, Markello, Samuel et al. (2003) Quality improvement in critical access hospitals: addressing immunizations prior to discharge. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association 19(4): 433-8	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Ellis, Catherine; Roland, Damian; Blair, Mitch E (2013) Professional educational interventions designed to improve knowledge and uptake of immunisation. Community practitioner : the journal of the Community Practitioners' & Health Visitors' Association 86(6): 20-3	- More recent systematic review identified that covers the same topic
Ernst, Kimberly D (2017) Electronic Alerts Improve Immunization Rates in Two-month-old Premature Infants Hospitalized in the Neonatal Intensive Care Unit. Applied clinical informatics 8(1): 206-213	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Fadda, Marta, Galimberti, Elisa, Fiordelli, Maddalena et al. (2018) Evaluation of a Mobile Phone-Based Intervention to Increase Parents' Knowledge About the Measles-Mumps-Rubella Vaccination and Their Psychological Empowerment: Mixed-Method Approach. JMIR mHealth and uHealth 6(3): e59	- Does not contain an outcome of relevance to this review
Fairbrother, G., Friedman, S., Hanson, K.L. et al. (1997) Effect of the vaccines for children program on inner-city neighborhood physicians. Archives of Pediatrics and Adolescent Medicine 151(12): 1229-1235	- The intervention is a free vaccine- not in scope
Fiks, AG; Luan, X; Mayne, SL (2016) Improving HPV Vaccination Rates Using Maintenance-of-Certification Requirements. Pediatrics 137(3): e20150675	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Findley, Sally E, Irigoyen, Matilde, Sanchez, Martha et al. (2008) Effectiveness of a community coalition for improving child vaccination rates in New York City. American journal of public health 98(11): 1959-62	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Fishbein, DB, Willis, BC, Cassidy, WM et al. (2006) A comprehensive patient assessment and physician reminder tool for adult immunization: effect on vaccine administration. Vaccine 24(18): 3971-3983	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Fisher-Borne, Marcie, Preiss, Alexander J, Black, Molly et al. (2018) Early Outcomes of a Multilevel Human Papillomavirus Vaccination Pilot Intervention in Federally Qualified Health Centers. Academic pediatrics 18(2s): 79-s84	- Data not reported in an extractable format *The number of participants was not provided.*

Study	Reason for exclusion
Flanagan, J R, Doebbeling, B N, Dawson, J et al. (1999) Randomized study of online vaccine reminders in adult primary care. Proceedings. AMIA Symposium: 755-9	- Does not contain an outcome of relevance to this review *Study reports ordering of vaccination by physician not if it was administered.*
Flood, T., Wilson, I.M., Prue, G. et al. (2020) Impact of school-based educational interventions in middle adolescent populations (15-17yrs) on human papillomavirus (HPV) vaccination uptake and perceptions/knowledge of HPV and its associated cancers: A systematic review. Preventive Medicine 139: 106168	- Systematic review used as source of primary studies *Some studies are non-OECD*
Fogarty, Kieran J, Massoudi, Mehran S, Gallo, William et al. (2004) Vaccine coverage levels after implementation of a middle school vaccination requirement, Florida, 1997-2000. Public health reports (Washington, D.C. : 1974) 119(2): 163-9	- Does not contain an outcome of relevance to this review *This study only reports data after the intervention is implemented - there is no 'before' comparison data.*
Forbes, Thomas A, McMinn, Alissa, Crawford, Nigel et al. (2015) Vaccination uptake by vaccine-hesitant parents attending a specialist immunization clinic in Australia. Human vaccines & immunotherapeutics 11(12): 2895-903	- Does not contain an outcome of relevance to this review *This study does not have a comparator.*
Ford, A.J. and Alwan, N.A. (2018) Use of social networking sites and women's decision to receive vaccinations during pregnancy: A cross-sectional study in the UK. Vaccine 36(35): 5294-5303	- Does not contain an outcome of relevance to this review
Forster, A, Cornelius, V, Rockliffe, L et al. (2018) A cluster randomised feasibility study of an adolescent incentive intervention to increase uptake of HPV vaccination. British journal of cancer. Conference: 2018 national cancer research institute cancer conference, NCRI 2018. United kingdom 119(1): 34	- Conference abstract
Forster, Alice S, Cornelius, Victoria, Rockliffe, Lauren et al. (2017) A protocol for a cluster randomised feasibility study of an adolescent incentive intervention to increase uptake of HPV vaccination among girls. Pilot and feasibility studies 3: 13	- Protocol for a future study *This is the protocol for Forester 2018, which is also considered in this review.*

Study	Reason for exclusion
Forster, Alice S, Cornelius, Victoria, Rockliffe, Lauren et al. (2017) A cluster randomised feasibility study of an adolescent incentive intervention to increase uptake of HPV vaccination. British journal of cancer 117(8): 1121-1127	- Does not contain an outcome of relevance to this review *Vaccine uptake may have been recorded during the study but the data was not included in the results section.*
Frame, P S, Zimmer, J G, Werth, P L et al. (1994) Computer-based vs manual health maintenance tracking. A controlled trial. Archives of family medicine 3(7): 581-8	- Vaccine on UK routine schedule but wrong context for administration *Study is about adult tetanus boosters in the USA.*
Francis, Diane B, Cates, Joan R, Wagner, Kyla P Garrett et al. (2017) Communication technologies to improve HPV vaccination initiation and completion: A systematic review. Patient education and counseling 100(7): 1280-1286	- More recent systematic review identified that covers the same topic
Franco, M., Mazzucca, S., Padek, M. et al. (2019) Going beyond the individual: how state-level characteristics relate to HPV vaccine rates in the United States. BMC public health 19(1): 246	- Not a relevant study design *This is a snap-shot of a national survey.*
Franzini, Luisa; Boom, Julie; Nelson, Cynthia (2007) Cost-effectiveness analysis of a practice-based immunization education intervention. Ambulatory pediatrics : the official journal of the Ambulatory Pediatric Association 7(2): 167-75	- Study includes data on a vaccine that is not on the UK routine vaccination schedule *This study does not separate out the data on varicella vaccine uptake, which is not on the UK routine vaccination schedule.*
Frascella, B., Oradini-Alacreu, A., Balzarini, F. et al. (2020) Effectiveness of email-based reminders to increase vaccine uptake: a systematic review. Vaccine 38(3): 433-443	- Systematic review used as source of primary studies

Study	Reason for exclusion
Free, Caroline, Phillips, Gemma, Felix, Lambert et al. (2010) The effectiveness of M-health technologies for improving health and health services: a systematic review protocol. BMC research notes 3: 250	- Review article but not a systematic review
Frew PM, Owens LE, Saint-Victor DS et al. (2014) Factors associated with maternal influenza immunization decision-making. Evidence of immunization history and message framing effects. Human vaccines & immunotherapeutics 10(9): 2576-2583	- Does not contain an outcome of relevance to this review *The outcome is intention to vaccinate, not vaccine uptake.*
Frew, Paula M and Lutz, Chelsea S (2017) Interventions to increase pediatric vaccine uptake: An overview of recent findings. Human vaccines & immunotherapeutics 13(11): 2503-2511	- Systematic review used as source of primary studies
Fried, Bruce J, Keyes-Elstein, Lynette, Lannon, Carole M et al. (2004) Practice based education to improve delivery systems for prevention in primary care: randomised trial. British Medical Journal 328(7436): 388-392	- Duplicate reference *This study is the same as Margolis 2004, which was excluded because the vaccine uptake data is only presented in a chart. This abstract entry has a different order of authors. It is otherwise identical.*
Frère J, De Wals P, Ovetchkine P et al. (2013) Evaluation of several approaches to immunize parents of neonates against B. pertussis. Vaccine 31(51): 6087-6091	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Fu, Linda Y, Bonhomme, Lize-Anne, Cooper, Spring Chenoa et al. (2014) Educational interventions to increase HPV vaccination acceptance: a systematic review. Vaccine 32(17): 1901-20	- More recent systematic review identified that covers the same topic
Fu, LY, Zook, K, Gingold, JA et al. (2016) Strategies for Improving Vaccine Delivery: a Cluster-Randomized Trial. Pediatrics 137(6)	- Study includes data on a vaccine that is not on the UK routine vaccination schedule *Varicella vaccine is not on the UK routine vaccination schedule and it is not*

Study	Reason for exclusion
	possible to separate this data out from other vaccines' uptake data.
Fujiwara, Hiroyuki, Takei, Yuji, Ishikawa, Yoshiki et al. (2013) Community-based interventions to improve HPV vaccination coverage among 13- to 15-year-old females: measures implemented by local governments in Japan. PloS one 8(12): e84126	- Not a relevant study design *This is a survey that analyses interventions as if they were 'risk factors' increasing uptake.*
Gaglani, M, Riggs, M, Kamenicky, C et al. (2001) A computerized reminder strategy is effective for annual influenza immunization of children with asthma or reactive airway disease. The Pediatric infectious disease journal 20(12): 1155-60	- The study did not report any of the outcomes specified in the protocol
Gagneur, Arnaud, Lemaitre, Thomas, Gosselin, Virginie et al. (2018) A postpartum vaccination promotion intervention using motivational interviewing techniques improves short-term vaccine coverage: PromoVac study. BMC public health 18(1): 811	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Gamble, George R; Goldstein, Adam O; Bearman, Rachel S (2008) Implementing a standing order immunization policy: a minimalist intervention. Journal of the American Board of Family Medicine : JABFM 21(1): 38-44	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Gannon M, Qaseem A, Snooks Q et al. (2012) Improving adult immunization practices using a team approach in the primary care setting. American journal of public health 102(7): e46	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Gargano, Lisa M, Herbert, Natasha L, Painter, Julia E et al. (2014) Development, theoretical framework, and evaluation of a parent and teacher-delivered intervention on adolescent vaccination. Health promotion practice 15(4): 556-67	- Does not contain an outcome of relevance to this review

Study	Reason for exclusion
Gates, A., Gates, M., Rahman, S. et al. (2021) A systematic review of factors that influence the acceptability of vaccines among Canadians. Vaccine 39(2): 222-236	- Not a relevant study design
Gazibara, T.; Jia, H.; Lubetkin, E.I. (2017) Trends in HPV vaccine initiation and completion among girls in Texas: Behavioral risk factor surveillance system data, 2008-2010. Puerto Rico Health Sciences Journal 36(3): 152-158	- Study does not contain an intervention aimed at increasing vaccine uptake
Gellert, Paul; Bethke, Norma; Seybold, Joachim (2019) School-based educational and on-site vaccination intervention among adolescents: study protocol of a cluster randomised controlled trial. BMJ open 9(1): e025113	- Protocol for a future study
Ghadieh, A.S., Hamadeh, G.N., Mahmassani, D.M. et al. (2015) The effect of various types of patients' reminders on the uptake of pneumococcal vaccine in adults: A randomized controlled trial. Vaccine 33(43): 5868-5872	- Study took place in a non-OECD country *Lebanon*
Gidengil, Courtney, Chen, Christine, Parker, Andrew M et al. (2019) Beliefs around childhood vaccines in the United States: A systematic review. Vaccine 37(45): 6793-6802	- Not a relevant study design *Qualitative study - considered for the qualitative review*
Giles EL, Robalino S, McColl E, Sniehotta FF, Adams J (2014) The effectiveness of financial incentives for health behaviour change: systematic review and meta-analysis. PLOS ONE 9(3): e90347	- Systematic review that does not include the outcomes stated in the protocol *Review focuses on financial incentives for behaviour change and covers changes in vaccination, but included references are not for routine vaccinations included in our protocol.*
Gilkey, Melissa B and McRee, Annie-Laurie (2016) Provider communication about HPV vaccination: A systematic review. Human vaccines & immunotherapeutics 12(6): 1454-68	- Systematic review that does not include relevant study types *Review of surveys and qualitative studies*

Study	Reason for exclusion
Gindler, J.S., Cutts, F.T., Barnett-Antinori, M.E. et al. (1993) Successes and failures in vaccine delivery: Evaluation of the immunization delivery system in Puerto Rico. Pediatrics 91(2): 315-320	- Not a relevant study design *Survey snapshot of Puerto Rico.*
Girard, Dorota Zdanowska (2012) Recommended or mandatory pertussis vaccination policy in developed countries: does the choice matter?. Public health 126(2): 117-22	- Review article but not a systematic review
Gleeson S; Kelleher K; Gardner W (2016) Evaluating a Pay-for-Performance Program for Medicaid Children in an Accountable Care Organization. JAMA pediatrics 170(3): 259-266	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before and after study.*
Glenton, Claire, Scheel, Inger B, Lewin, Simon et al. (2011) Can lay health workers increase the uptake of childhood immunisation? Systematic review and typology. Tropical medicine & international health : TM & IH 16(9): 1044-53	- Systematic review used as source of primary studies
Goebel, LJ (1997) A peer review feedback method of promoting compliance with preventive care guidelines in a resident ambulatory care clinic. Joint Commission journal on quality improvement 23(4): 196-202	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Golden, Shelley D, Moracco, Kathryn E, Feld, Ashley L et al. (2014) Process evaluation of an intervention to increase provision of adolescent vaccines at school health centers. Health education & behavior : the official publication of the Society for Public Health Education 41(6): 625-32	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Gordon, Louisa G, Holden, Libby, Ware, Robert S et al. (2012) Comprehensive health assessments for adults with intellectual disability living in the community: Weighing up the costs and benefits. Australian Family Physician 41(12): 969-72	- Vaccine on UK routine schedule but wrong context for administration *The mean age of participants was 36 years (SD 13). For the pneumonia vaccine. This is younger than the committee's cut-off mean age of 50 years.*

Study	Reason for exclusion
Gori, D., Costantino, C., Odone, A. et al. (2020) The impact of mandatory vaccination law in Italy on mmr coverage rates in two of the largest italian regions (Emilia-romagna and sicily): An effective strategy to contrast vaccine hesitancy. Vaccines 8(1): 57	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Gosselin Boucher, Vincent, Colmegna, Ines, Gemme, Claudia et al. (2019) Interventions to improve vaccine acceptance among rheumatoid arthritis patients: a systematic review. Clinical rheumatology 38(6): 1537-1544	- Systematic review used as source of primary studies
Gottlieb, N H, Huang, P P, Blozis, S A et al. (2001) The impact of Put Prevention into Practice on selected clinical preventive services in five Texas sites. American journal of preventive medicine 21(1): 35-40	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Grant, C.C., Turner, N.M., York, D.G. et al. (2010) Factors associated with immunisation coverage and timeliness in New Zealand. British Journal of General Practice 60(572): 180-186	- Not a relevant study design *Survey snapshot of New Zealand.*
Green, D., Labriola, G., Smeaton, L. et al. (2017) Prevention of neonatal whooping cough in England: The essential role of the midwife. British Journal of Midwifery 25(4): 224-228	- Review article but not a systematic review
Greyson, Devon; Vriesema-Magnuson, Chris; Bettinger, Julie A (2019) Impact of school vaccination mandates on pediatric vaccination coverage: a systematic review. CMAJ open 7(3): e524-e536	- Systematic review used as source of primary studies
Groom, Holly C, Irving, Stephanie A, Caldwell, Jessica et al. (2017) Implementing a Multipartner HPV Vaccination Assessment and Feedback Intervention in an Integrated Health System. Journal of public health management and practice : JPHMP 23(6): 589-592	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Groom, Holly, Hopkins, David P, Pabst, Laura J et al. (2015) Immunization information systems to increase vaccination rates: a	- Systematic review used as source of primary studies

Study	Reason for exclusion
community guide systematic review. Journal of public health management and practice : JPHMP 21(3): 227-48	
Gruber, T and Marada, R (2000) Improving pneumococcal vaccination rates for elderly patients. New Jersey medicine : the journal of the Medical Society of New Jersey 97(2): 35-9	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review *This was a before-and-after study.*
Guo, J.-L.; Gottlieb, N.H.; Huang, C.-M. (2002) Effects of office system and educational interventions in increasing the delivery of preventive health services: A meta-analysis. Taiwan Journal of Public Health 21(1): 36-51	- More recent systematic review identified that covers the same topic *SR is not specific to increasing vaccination and other more relevant and up to date SRs identified.*
Gust, Deborah A, Kennedy, Allison, Weber, Deanne et al. (2009) Parents questioning immunization: evaluation of an intervention. American journal of health behavior 33(3): 287-98	- Does not contain an outcome of relevance to this review
Haesebaert J, Lutringer-Magnin D, Kalecinski J et al. (2012) French women's knowledge of and attitudes towards cervical cancer prevention and the acceptability of HPV vaccination among those with 14 - 18 year old daughters: a quantitative-qualitative study. BMC public health 12: 1034	- The study did not report any of the outcomes specified in the protocol
Haji, Adam, Lowther, S, Ngan'ga, Z et al. (2016) Reducing routine vaccination dropout rates: evaluating two interventions in three Kenyan districts, 2014. BMC public health 16: 152	- Study took place in a non-OECD country
Hajizadeh, Mohammad, Heymann, Jody, Strumpf, Erin et al. (2015) Paid maternity leave and childhood vaccination uptake: Longitudinal evidence from 20 low-and-middle-income countries. Social science & medicine (1982) 140: 104-17	- Systematic review of non-OECD countries
Hakim, Hina, Provencher, Thierry, Chambers, Christine T et al. (2019) Interventions to help people understand community immunity: A systematic review. Vaccine 37(2): 235-247	- Systematic review used as source of primary studies
Hansen, P.R.; Schmidtblaicher, M.; Brewer, N.T. (2020) Resilience of HPV vaccine uptake in Denmark: Decline and recovery. Vaccine 38(7): 1842-1848	- Education non-RCT. Excluded because there

Study	Reason for exclusion
	was sufficient RCT evidence for this review
Harper, P and Madlon-Kay, D J (1994) Adolescent measles vaccination. Response rates to mailings addressed to patients vs parents. Archives of family medicine 3(7): 619-22	- Study participants are the wrong age group *This study is a measles catch-up campaign for adolescents aged 12 to 18 years. MMR is on the routine schedule for children aged 0-5 years. Catch-up campaigns are out of scope.*
Harvey, Hannah; Reissland, Nadja; Mason, James (2015) Parental reminder, recall and educational interventions to improve early childhood immunisation uptake: A systematic review and meta-analysis. Vaccine 33(25): 2862-80	- Systematic review used as source of primary studies
Hastings, Tessa J, Hohmann, Lindsey A, Huston, Sally A et al. (2020) Enhancing pharmacy personnel immunization-related confidence, perceived barriers, and perceived influence: The We Immunize program. Journal of the American Pharmacists Association : JAPhA 60(2): 344-351e2	- Does not contain an outcome of relevance to this review
Hayles, Elizabeth Helen, Cooper, Spring Chenoa, Wood, Nicholas et al. (2015) What predicts postpartum pertussis booster vaccination? A controlled intervention trial. Vaccine 33(1): 228-36	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Healy CM, Ng N, Taylor RS et al. (2015) Tetanus and diphtheria toxoids and acellular pertussis vaccine uptake during pregnancy in a metropolitan tertiary care center. Vaccine 33(38): 4983-4987	- Data not reported in an extractable format *The number of participants in each cohort was not provided.*
Hechter, Rulin C, Qian, Lei, Luo, Yi et al. (2019) Impact of an electronic medical record reminder on hepatitis B vaccine initiation and completion rates among insured adults with diabetes mellitus. Vaccine 37(1): 195-201	- Vaccine on UK routine schedule but wrong context for administration *This study is about HepB vaccination for adults.*

Study	Reason for exclusion
Hempstead, K., Bresnitz, E., Howell-White, S. et al. (2004) Use of a state regulation for adult vaccination. American Journal of Preventive Medicine 26(4): 311-314	- Does not contain an outcome of relevance to this review
Henninger, Michelle L, Mcmullen, Carmit K, Firemark, Alison J et al. (2017) User-Centered Design for Developing Interventions to Improve Clinician Recommendation of Human Papillomavirus Vaccination. The Permanente journal 21: 16-191	- Not a relevant study design
Henrikson, N, Zhu, W, Nguyen, M et al. (2017) Health system-based HPV vaccine reminders: randomized trial results. Cancer epidemiology biomarkers and prevention 26(3): 435	- Conference abstract
Henry SL, Shen E, Ahuja A et al. (2016) The Online Personal Action Plan: A Tool to Transform Patient-Enabled Preventive and Chronic Care. American journal of preventive medicine 51(1): 71-77	- Not a relevant study design *Use of a website for education is treated as a risk factor for vaccine uptake. All participants had access to the same website.*
Herbert, N (2014) Parental attitudes and beliefs about human papillomavirus (HPV) vaccination and vaccine receipt among adolescents in richmond county, Georgia. Journal of adolescent health 54(2): S82	- Conference abstract
Herman, C.J.; Speroff, T.; Cebul, R.D. (1994) Improving compliance with immunization in the older adult: Results of a randomized cohort study. Journal of the American Geriatrics Society 42(11): 1154-1159	- Does not contain an outcome of relevance to this review *This study has data for vaccinations offered. This is not the same thing as uptake.*
Hicks, Paul; Tarr, Gillian A M; Hicks, Ximena Prieto (2007) Reminder cards and immunization rates among Latinos and the rural poor in Northeast Colorado. Journal of the American Board of Family Medicine : JABFM 20(6): 581-6	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Higginbotham, Suzanne; Stewart, Autumn; Pfalzgraf, Andrea (2012) Impact of a pharmacist immunizer on adult immunization rates. Journal of the American Pharmacists Association : JAPhA 52(3): 367-71	- Study participants are the wrong age group *The participants for all 3 arms have a mean age of*

Study	Reason for exclusion
	45 years (SD 12.1). This is the wrong age group for vaccines on the UK routine vaccination schedule.
Ho, Hanley J, Chan, Yin Ying, Ibrahim, Muhamad Alif Bin et al. (2017) A formative research-guided educational intervention to improve the knowledge and attitudes of seniors towards influenza and pneumococcal vaccinations. Vaccine 35(47): 6367-6374	- Does not contain an outcome of relevance to this review
Hofstetter, Annika M, Vargas, Celibell Y, Camargo, Stewin et al. (2015) Impacting delayed pediatric influenza vaccination: a randomized controlled trial of text message reminders. American journal of preventive medicine 48(4): 392-401	- The study did not report any of the outcomes specified in the protocol
Hohmann, L.A., Hastings, T.J., Ha, D.R. et al. (2019) Impact of a multi-component immunization intervention on pneumococcal and herpes zoster vaccinations: A randomized controlled trial of community pharmacies in 2 states. Research in social & administrative pharmacy : RSAP 15(12): 1453-1463	- The study did not report any of the outcomes specified in the protocol *And unable to determine what proportion of individuals were over 65 years of age*
Hohmann, L, Hastings, T, Garza, K et al. (2018) Impact of a multicomponent immunization intervention on pneumococcal and herpes zoster vaccinations: a randomized controlled trial of community pharmacies in two states. Journal of the american pharmacists association 58(3): e71	- Conference abstract
Holloway, Ginger L (2019) Effective HPV Vaccination Strategies: What Does the Evidence Say? An Integrated Literature Review. Journal of pediatric nursing 44: 31-41	- Review article but not a systematic review
Holzman, GS, Harwell, TS, Johnson, EA et al. (2005) A media campaign to promote pneumococcal vaccinations: is a telephone survey an effective evaluation strategy?. Journal of public health management and practice 11(3): 228-234	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Hopfer S, Ray AE, Hecht ML et al. Taking an HPV vaccine research-tested intervention to scale in a clinical setting. Translational behavioral medicine 8(5): 745-752	- The study did not report any of the outcomes specified in the protocol

Study	Reason for exclusion
Houle, Sherilyn K D, McAlister, Finlay A, Jackevicius, Cynthia A et al. (2012) Does performance-based remuneration for individual health care practitioners affect patient care?: a systematic review. Annals of internal medicine 157(12): 889-99	- Systematic review used as source of primary studies
Hui, Charles, Dunn, Jessica, Morton, Rachael et al. (2018) Interventions to Improve Vaccination Uptake and Cost Effectiveness of Vaccination Strategies in Newly Arrived Migrants in the EU/EEA: A Systematic Review. International journal of environmental research and public health 15(10)	- Systematic review used as source of primary studies
Hull, Sally, Hagdrup, Nicola, Hart, Ben et al. (2002) Boosting uptake of influenza immunisation: a randomised controlled trial of telephone appointing in general practice. The British journal of general practice : the journal of the Royal College of General Practitioners 52(482): 712-6	- The study did not report any of the outcomes specified in the protocol
Hutchinson, A.F. and Smith, S.M. (2020) Effectiveness of strategies to increase uptake of pertussis vaccination by new parents and family caregivers: A systematic review. Midwifery 87: 102734	- Systematic review used as source of primary studies
Ibikunle-Salami, Tawa B (2016) Educational intervention to impact parental decisions to consent to Human Papillomavirus vaccine. Dissertation Abstracts International: Section B: The Sciences and Engineering 77(2be): no-specified	- Not a peer-reviewed publication
Ibáñez-Jiménez, A, Pairet-Jofre, G, Prat-González, I et al. (2007) Randomized clinical trial on the effectiveness of a postal reminder to increase tetanus-diphtheria vaccination coverage in the young adult population. Enfermeria clinica 17(4): 171-176	- Study not reported in English
Interaminense, I.N.C.S., de Oliveira, S.C., Leal, L.P. et al. (2016) Educational technologies to promote vaccination against human papillomavirus: Integrative literature review. Texto e Contexto Enfermagem 25(2): e2300015	- More recent systematic review identified that covers the same topic
Irigoyen, M M, Findley, S, Earle, B et al. (2000) Impact of appointment reminders on vaccination coverage at an urban clinic. Pediatrics 106(4suppl): 919-23	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Irigoyen, M., Findley, S.E., Chen, S. et al. (2004) Early continuity of care and immunization coverage. Ambulatory Pediatrics 4(3): 199-203	- Does not contain an outcome of relevance to this review *This study does not compare one arm against another. Continuity of care*

Study	Reason for exclusion
	is analysed like a risk factor for vaccination.
Irving, S.A.; Salmon, D.A.; Curbow, B.A. (2007) Vaccine risk communication interventions in the United States, 1996-2006: A review. Current Pediatric Reviews 3(3): 238-247	- More recent systematic review identified that covers the same topic
Isaac, Michael R, Chartier, Mariette, Brownell, Marni et al. (2015) Can opportunities be enhanced for vaccinating children in home visiting programs? A population-based cohort study. BMC Public Health 15(620)	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Isenor, J E, Edwards, N T, Alia, T A et al. (2016) Impact of pharmacists as immunizers on vaccination rates: A systematic review and meta-analysis. Vaccine 34(47): 5708-5723	- Systematic review used as source of primary studies
Isenor, J.E., Kervin, M.S., Halperin, D.M. et al. (2020) Pharmacists as immunizers to Improve coverage and provider/recipient satisfaction: A prospective, Controlled Community Embedded Study with vaccineS with low coverage rates (the Improve ACCESS Study): Study summary and anticipated significance. Canadian Pharmacists Journal 153(2): 88-94	- Protocol for a future study
ISRCTN20165116 (2003) Randomised trial of pre-pregnancy information and counselling in inner urban Melbourne. http://www.who.int/trialsearch/Trial2.aspx?TrialID=ISRCTN20165116	- Does not contain an outcome of relevance to this review *This is a study registration. They went on to look at birth weight but not vaccine uptake.*
Ito, Tomoko, Takenoshita, Remi, Narumoto, Keiichiro et al. (2014) A community-based intervention in middle schools to improve HPV vaccination and cervical cancer screening in Japan. Asia Pacific family medicine 13(1): 13	- Does not contain an outcome of relevance to this review
Jaca, Anelisa, Mathebula, Lindi, Iweze, Arthur et al. (2018) A systematic review of strategies for reducing missed opportunities for vaccination. Vaccine 36(21): 2921-2927	- Systematic review used as source of primary studies
Jacob, Verughese, Chattopadhyay, Sajal K, Hopkins, David P et al. (2016) Increasing Coverage of Appropriate Vaccinations: A	- Systematic review used as source of primary studies

Study	Reason for exclusion
Community Guide Systematic Economic Review. American journal of preventive medicine 50(6): 797-808	
Jacobs-Wingo, Jasmine L; Jim, Cheyenne C; Groom, Amy V (2017) Human Papillomavirus Vaccine Uptake: Increase for American Indian Adolescents, 2013-2015. American journal of preventive medicine 53(2): 162-168	- Not a relevant study design *This is a survey that looks for associations / risk factors that appear to increase or decrease vaccine uptake.*
Jarrett, Caitlin, Wilson, Rose, O'Leary, Maureen et al. (2015) Strategies for addressing vaccine hesitancy - A systematic review. Vaccine 33(34): 4180-90	- Systematic review used as source of primary studies
Jeannot, Emilien; Petignat, Patrick; Sudre, Philippe (2015) Successful Implementation and Results of an HPV Vaccination Program in Geneva Canton, Switzerland. Public Health Reports 130(3): 202-206	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Joffe, M.D. and Luberti, A. (1994) Effect of emergency department immunization on compliance with primary care. Pediatric Emergency Care 10(6): 317-319	- The intervention is a free vaccine- not in scope
Johnson, Elizabeth A, Harwell, Todd S, Donahue, Peg M et al. (2003) Promoting pneumococcal immunizations among rural Medicare beneficiaries using multiple strategies. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association 19(4): 506-10	- Does not contain an outcome of relevance to this review *Does not state number or % vaccinated*
Johnston, Jennifer Cyne, McNeil, Deborah, Lee, Germaeline et al. (2017) Piloting CenteringParenting in Two Alberta Public Health Well-Child Clinics. Public Health Nursing 34(3): 229-237	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Jordan, Elizabeth T, Bushar, Jessica A, Kendrick, Juliette S et al. (2015) Encouraging Influenza Vaccination Among Text4baby Pregnant Women and Mothers. American journal of preventive medicine 49(4): 563-72	- The study did not report any of the outcomes specified in the protocol

Study	Reason for exclusion
Jung, Jesse J, Elkin, Zachary P, Li, Xiaochun et al. (2013) Increasing use of the vaccine against zoster through recommendation and administration by ophthalmologists at a city hospital. American journal of ophthalmology 155(5): 787-95	- The study did not report any of the outcomes specified in the protocol
Juon, Hee-Soon, Strong, Carol, Kim, Frederic et al. (2016) Lay Health Worker Intervention Improved Compliance with Hepatitis B Vaccination in Asian Americans: Randomized Controlled Trial. PloS one 11(9): e0162683	- Study participants are the wrong age group *In the UK, HepB routine vaccination is for infants. Participants in this study are all adults.*
Kamath, Geetanjali (2018) Hepatitis-B vaccination, behavioral cognitions, and changing risk behaviors among a drug using population: Findings from a cluster randomized controlled trial. Dissertation Abstracts International: Section B: The Sciences and Engineering 78(10be): no-specified	- Conference abstract
Katz ML, Oldach BR, Goodwin J et al. (2014) Development and initial feedback about a human papillomavirus (HPV) vaccine comic book for adolescents. Journal of cancer education : the official journal of the American Association for Cancer Education 29(2): 318-324	- The study did not report any of the outcomes specified in the protocol
Kaufman, Jessica, Ryan, Rebecca, Walsh, Louisa et al. (2018) Face-to-face interventions for informing or educating parents about early childhood vaccination. The Cochrane database of systematic reviews 5: cd010038	- Duplicate reference
Kaufman, Jessica, Ryan, Rebecca, Walsh, Louisa et al. (2018) Face-to-face interventions for informing or educating parents about early childhood vaccination. The Cochrane database of systematic reviews 5: cd010038	- Duplicate reference
Kaufman, Jessica, Ryan, Rebecca, Walsh, Louisa et al. (2018) Face-to-face interventions for informing or educating parents about early childhood vaccination. The Cochrane database of systematic reviews 5: cd010038	- Duplicate reference
Kaufman, Jessica, Synnot, Anneliese, Ryan, Rebecca et al. (2013) Face to face interventions for informing or educating parents about early childhood vaccination. The Cochrane database of systematic reviews: cd010038	- More recent systematic review identified that covers the same topic
Kempe, Allison, Saville, Alison, Dickinson, L Miriam et al. (2013) Population-based versus practice-based recall for childhood	- Study includes data on a vaccine that is not on the

Study	Reason for exclusion
immunizations: a randomized controlled comparative effectiveness trial. American journal of public health 103(6): 1116-23	UK routine vaccination schedule *Varicella vaccine uptake was incorporated into the data and could not be separated.*
Kendrick, D, Hewitt, M, Dewey, M et al. (2002) The effect of home visiting programmes on uptake of childhood immunization: a systematic review and meta-analysis. British Journal of Clinical Governance 7(1): 51-52	- Duplicate reference *This is a reprint of Kendrick 2000, which has been considered in this evidence review.*
Kendrick, D, Hewitt, M, Dewey, M et al. (2000) The effect of home visiting programmes on uptake of childhood immunization: a systematic review and meta-analysis. Journal of public health medicine 22(1): 90-8	- Systematic review used as source of primary studies
Kim, C S, Kristopaitis, R J, Stone, E et al. (1999) Physician education and report cards: do they make the grade? results from a randomized controlled trial. The American journal of medicine 107(6): 556-60	- Does not contain an outcome of relevance to this review
Kim, J (2020) The impact of narrative strategy on promoting HPV vaccination among college students in korea: the role of anticipated regret. Vaccines 8(2)	- The study did not report any of the outcomes specified in the protocol - Vaccine on UK routine schedule but wrong context for administration *Vaccination of university students for HPV is not on the UK routine schedule.*
Kim, M, Lee, H, Aronowitz, T et al. (2018) An online-based storytelling video intervention on promoting Korean American female college students' HPV vaccine uptake. Cancer epidemiology biomarkers and prevention 27(7)	- Conference abstract
Kim, MinJin (2018) "I want to know more about the HPV vaccine": Stories by Korean American college women. Dissertation Abstracts International: Section B: The Sciences and Engineering 79(4be): no-specified	- Not a peer-reviewed publication

Study	Reason for exclusion
Kim, Sujin; Hughes, Christine A; Sadowski, Cheryl A (2014) A review of acute care interventions to improve inpatient pneumococcal vaccination. Preventive medicine 67: 119-27	- Systematic review used as source of primary studies
Klein, R S and Adachi, N (1983) Pneumococcal vaccine in the hospital. Improved use and implications for high-risk patients. Archives of internal medicine 143(10): 1878-81	- Study published before 1990 date limit set in review protocol
Klein, RS and Adachi, N (1986) An effective hospital-based pneumococcal immunization program. Archives of internal medicine 146(2): 327-329	- Study published before 1990 date limit set in review protocol
Kolasa, M S, Petersen, T J, Brink, E W et al. (2001) Impact of multiple injections on immunization rates among vulnerable children. American journal of preventive medicine 21(4): 261-6	- Study looks at intervention in the context of introducing a new vaccine
Kolasa, M.S., Chilkatowsky, A.P., Stevenson, J.M. et al. (2003) Do laws bring children in child care centers up to date for immunizations?. Ambulatory Pediatrics 3(3): 154-157	- The study did not report any of the outcomes specified in the protocol
Koniak-Griffin D, Anderson NL, Brecht ML et al. (2002) Public health nursing care for adolescent mothers: impact on infant health and selected maternal outcomes at 1 year postbirth. The Journal of adolescent health : official publication of the Society for Adolescent Medicine 30(1): 44-54	- Duplicate reference *These are the preliminary findings of Koniak-Griffin 2003, which has also been considered in this review.*
Korn, Lars, Betsch, Cornelia, Bohm, Robert et al. (2018) Social nudging: The effect of social feedback interventions on vaccine uptake. Health psychology : official journal of the Division of Health Psychology, American Psychological Association 37(11): 1045-1054	- Does not contain an outcome of relevance to this review
Krantz, Landon, Ollberding, Nicholas J, Beck, Andrew F et al. (2018) Increasing HPV Vaccination Coverage Through Provider-Based Interventions. Clinical pediatrics 57(3): 319-326	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This is a before-and-after study.*

Study	Reason for exclusion
Kreuter, Matthew W, Caburnay, Charlene A, Chen, John J et al. (2004) Effectiveness of individually tailored calendars in promoting childhood immunization in urban public health centers. American journal of public health 94(1): 122-7	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Krishnaswamy, S., Wallace, E.M., Buttery, J. et al. (2018) Strategies to implement maternal vaccination: A comparison between standing orders for midwife delivery, a hospital based maternal immunisation service and primary care. Vaccine 36(13): 1796-1800	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Kruspe, Rachel, Lillis, Rebecca, Daberkow, Dayton W 2nd et al. (2003) Education does pay off: pneumococcal vaccine screening and administration in hospitalized adult patients with pneumonia. The Journal of the Louisiana State Medical Society : official organ of the Louisiana State Medical Society 155(6): 325-31	- Vaccine on UK routine schedule but wrong context for administration *This study looks at hospital vaccination in the context of managing pneumonia rather than uptake in the general population of people 65+ years old.*
Kuehne, Flora, Sanftenberg, Linda, Dreischulte, Tobias et al. (2020) Shared Decision Making Enhances Pneumococcal Vaccination Rates in Adult Patients in Outpatient Care. International journal of environmental research and public health 17(23)	- Systematic review used as source of primary studies
Kumar, Rajesh (2014) Effective messages in vaccine promotion: a randomised trial: public health viewpoint. Indian pediatrics 51(6): 493	- Not a peer-reviewed publication *This is a letter about Nyhan 2014. Nyhan 2014 was excluded because it did not have an outcome of relevance to this review.*
Kuria, Patrick; Brook, Gary; McSorley, John (2016) The effect of electronic patient records on hepatitis B vaccination completion rates at a genitourinary medicine clinic. International journal of STD & AIDS 27(6): 486-9	- Vaccine on UK routine schedule but wrong context for administration *This is an adult study on HepB vaccination.*

Study	Reason for exclusion
Lam LP and McLaws ML (1998) Hepatitis B vaccination coverage of Vietnamese children in south-western Sydney. Australian and New Zealand journal of public health 22(4): 502-504	- Vaccine on UK routine schedule but wrong context for administration
Lam, Sum and Jodlowski, Tomas Z (2009) Vaccines for older adults. The Consultant pharmacist : the journal of the American Society of Consultant Pharmacists 24(5): 380-91	- Review article but not a systematic review
Lau, Darren, Hu, Jia, Majumdar, Sumit R et al. (2012) Interventions to improve influenza and pneumococcal vaccination rates among community-dwelling adults: a systematic review and meta-analysis. Annals of family medicine 10(6): 538-46	- Systematic review used as source of primary studies
Lawrence GL, MacIntyre CR, Hull BP et al. (2004) Effectiveness of the linkage of child care and maternity payments to childhood immunisation. Vaccine 22(17-18): 2345-2350	- Does not contain an outcome of relevance to this review
Lee, Cecilia and Robinson, Joan L (2016) Systematic review of the effect of immunization mandates on uptake of routine childhood immunizations. The Journal of infection 72(6): 659-666	- Systematic review used as source of primary studies
Lee, Haeok, Kim, Minjin, Allison, Jeroan et al. (2017) Development of a theory-guided storytelling narrative intervention to improve HPV vaccination behavior: Save our daughters from cervical cancer. Applied nursing research : ANR 34: 57-61	- Protocol linked to an included study or paper
Lee, Hee Yun, Koopmeiners, Joseph S, McHugh, Jennifer et al. (2016) mHealth Pilot Study: Text Messaging Intervention to Promote HPV Vaccination. American journal of health behavior 40(1): 67-76	- Does not contain an outcome of relevance to this review *This study does not have a comparator.*
Lefevere, Eva, Hens, Niel, De Smet, Frank et al. (2016) The impact of non-financial and financial encouragements on participation in non school-based human papillomavirus vaccination: a retrospective cohort study. The European journal of health economics : HEPAC : health economics in prevention and care 17(3): 305-15	- The intervention is a free vaccine- not in scope *The financial encouragement is free vaccination. The non-financial encouragement is information, whichis in both arms of the study equally.*

Study	Reason for exclusion
Lemaitre, Thomas, Carrier, Nathalie, Farrands, Anne et al. (2019) Impact of a vaccination promotion intervention using motivational interview techniques on long-term vaccine coverage: the PromoVac strategy. Human vaccines & immunotherapeutics 15(3): 732-739	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Lieu TA, Glauber JH, Fuentes-Afflick E et al. (1994) Effects of vaccine information pamphlets on parents' attitudes. Archives of pediatrics & adolescent medicine 148(9): 921-925	- The study did not report any of the outcomes specified in the protocol
Lim, W Ting, Sears, Kim, Smith, Leah M et al. (2014) Evidence of effective delivery of the human papillomavirus (HPV) vaccine through a publicly funded, school-based program: the Ontario Grade 8 HPV Vaccine Cohort Study. BMC public health 14: 1029	- The study did not report any of the outcomes specified in the protocol *This study does not have a comparator.*
Lin, James L, Bacci, Jennifer L, Reynolds, Marci J et al. (2018) Comparison of two training methods in community pharmacy: Project VACCINATE. Journal of the American Pharmacists Association : JAPhA 58(4s): 94-s100e3	- Data not reported in an extractable format *Uptake was reported as percentages - the number of participants was not provided.*
Lin, S.-C., Tam, K.-W., Yen, J.Y.-C. et al. (2020) The impact of shared decision making with patient decision aids on the rotavirus vaccination rate in children: A randomized controlled trial. Preventive medicine: 106244	- Study took place in a non-OECD country
Linton, Leslie S, Peddecord, K Michael, Seidman, Robert L et al. (2003) Implementing a seventh grade vaccination law: school factors associated with completion of required immunizations. Preventive medicine 36(4): 510-7	- Not a relevant study design *This is a survey and does not specifically look at an intervention.*
Lopez, N., Garces-Sanchez, M., Panizo, M.B. et al. (2020) HPV knowledge and vaccine acceptance among European adolescents and their parents: A systematic literature review. Public Health Reviews 41(1): 10	- Not a relevant study design
Lu, P.-J., Yankey, D., Jeyarajah, J. et al. (2017) Impact of Provider Recommendation on Tdap Vaccination of Adolescents Aged 13-17 Years. American Journal of Preventive Medicine 53(3): 373-384	- Study does not contain an intervention aimed at increasing vaccine uptake

Study	Reason for exclusion
Lukusa, Lungeni Auguy, Ndze, Valantine Ngum, Mbeye, Nyanyiwe Masingi et al. (2018) A systematic review and meta-analysis of the effects of educating parents on the benefits and schedules of childhood vaccinations in low and middle-income countries. Human vaccines & immunotherapeutics 14(8): 2058-2068	- Systematic review of non-OECD countries
Ma, Grace X, Lee, Minsun M, Tan, Yin et al. (2018) Efficacy of a community-based participatory and multilevel intervention to enhance hepatitis B virus screening and vaccination in underserved Korean Americans. Cancer 124(5): 973-982	- Vaccine on UK routine schedule but wrong context for administration
MacDougall DM, Halperin BA, Langley JM et al. (2016) Knowledge, attitudes, beliefs, and behaviors of parents and healthcare providers before and after implementation of a universal rotavirus vaccination program. Vaccine 34(5): 687-695	- Study does not contain an intervention aimed at increasing vaccine uptake *This study compares patient and healthcare provider attitudes towards a physician-delivered programme compared to a nurse-delivered programme. However, there are no details of an intervention to increase uptake.*
Mackey, Jessica K, Thompson, Katie, Abdulwahab, Adeem et al. (2019) A Simple Intervention to Increase Human Papillomavirus Vaccination in a Family Medicine Practice. South Dakota medicine : the journal of the South Dakota State Medical Association 72(10): 438-441	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Macknin, J.; Marks, M.; Macknin, M.L. (2000) Effect of telephone follow-up on frequency of health maintenance visits among children attending free immunization clinics: A randomized, controlled trial. Clinical Pediatrics 39(11): 679-681	- Does not contain an outcome of relevance to this review *This study does not have any vaccine uptake data.*
Madlon-Kay, Diane J (2011) Effect of revised nursery orders on newborn preventive services. Journal of the American Board of Family Medicine : JABFM 24(6): 656-64	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Maertens, Julie A, Jimenez-Zambrano, Andrea M, Albright, Karen et al. (2017) Using Community Engagement to Develop a Web-Based Intervention for Latinos about the HPV Vaccine. Journal of health communication 22(4): 285-293	- Duplicate reference
Malo, Teri L, Hall, Megan E, Brewer, Noel T et al. (2018) Why is announcement training more effective than conversation training for introducing HPV vaccination? A theory-based investigation. Implementation science : IS 13(1): 57	- Does not contain an outcome of relevance to this review
Malone, Kathryn, Clark, Stephanie, Palmer, Jo Ann et al. (2016) A quality improvement initiative to increase pneumococcal vaccination coverage among children after kidney transplant. Pediatric transplantation 20(6): 783-9	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Manthey, David E; Stopyra, Jason; Askew, Kim (2004) Referral of emergency department patients for pneumococcal vaccination. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine 11(3): 271-5	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Mantzari, Eleni; Vogt, Florian; Marteau, Theresa M (2012) Using financial incentives to increase initial uptake and completion of HPV vaccinations: protocol for a randomised controlled trial. BMC health services research 12: 301	- Protocol for a future study *The RCT is Mantzari 2015 and it has been considered in this review*
Margolis PA, Lannon CM, Stuart JM et al. (2004) Practice based education to improve delivery systems for prevention in primary care: randomised trial. BMJ (Clinical research ed.) 328(7436): 388	- Data not reported in an extractable format *The vaccine uptake data is only presented in a chart.*
Mayne, Stephanie L, duRivage, Nathalie E, Feemster, Kristen A et al. (2014) Effect of decision support on missed opportunities for human papillomavirus vaccination. American journal of preventive medicine 47(6): 734-44	- The study did not report any of the outcomes specified in the protocol *Reports number of vaccinations given relative to number of visits, rather than number of people vaccinated*

Study	Reason for exclusion
McCaul, Kevin D; Johnson, Rebecca J; Rothman, Alexander J (2002) The effects of framing and action instructions on whether older adults obtain flu shots. Health psychology : official journal of the Division of Health Psychology, American Psychological Association 21(6): 624-8	- The study did not report any of the outcomes specified in the protocol
McRee, A-L; Shoben, AB; Reiter, PL (2018) Effects of a pilot randomized controlled trial of a web-based HPV vaccination intervention for young gay and bisexual men: the outsmart HPV project. Journal of adolescent health 62(2): S10	- Conference abstract
Meghea, C I, Li, B., Zhu, Q et al. (2013) Infant health effects of a nurse-community health worker home visitation programme: a randomized controlled trial. Child: Care, Health and Development 39(1): 27-35	- Study does not contain an intervention aimed at increasing vaccine uptake *This study has an intervention that includes parenting education. However, there is nothing specifically about increasing vaccine uptake.*
Melman, S T, Ehrlich, E S, Klugman, D et al. (2000) Compliance with initiation of a sequential schedule for polio immunization. Clinical pediatrics 39(1): 51-3	- Not a relevant study design
Mena Cantero, Alvin (2018) Educational Intervention for Engaging Adolescents and Their Parents in HPV Vaccination. Dissertation Abstracts International: Section B: The Sciences and Engineering 79(3be): no-specified	- Does not contain an outcome of relevance to this review
Meyer, Amanda F, Borkovskiy, Nicole L, Brickley, Jennifer L et al. (2018) Impact of Electronic Point-of-Care Prompts on Human Papillomavirus Vaccine Uptake in Retail Clinics. American journal of preventive medicine 55(6): 822-829	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Michail, G, Smaili, M, Vozikis, A et al. (2014) Female students receiving post-secondary education in Greece: the results of a collaborative human papillomavirus knowledge survey. Public health 128(12): 1099-105	- Not a relevant study design *This study is a survey - there is no comparator.*
Miles, L.W., Williams, N., Luthy, K.E. et al. (2020) Adult Vaccination Rates in the Mentally Ill Population: An Outpatient Improvement	- Does not contain an outcome of relevance to this review

Study	Reason for exclusion
Project. Journal of the American Psychiatric Nurses Association 26(2): 172-180	
Mills, Brittany, Fensterheim, Leonard, Taitel, Michael et al. (2014) Pharmacist-led Tdap vaccination of close contacts of neonates in a women's hospital. Vaccine 32(4): 521-5	- Study does not include a relevant population
Minkovitz, C S, Belote, A D, Higman, S M et al. (2001) Effectiveness of a practice-based intervention to increase vaccination rates and reduce missed opportunities. Archives of pediatrics & adolescent medicine 155(3): 382-6	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review *This was a before-and-after study.*
Mohan, Pavitra (2014) Effective messages in vaccine promotion: a randomised trial: public policy viewpoint. Indian pediatrics 51(6): 492	- Not a peer-reviewed publication *This is a letter about Nyhan 2014. Nyhan 2014 was excluded because it did not have an outcome of relevance to this review.*
Mohr, J.J., Randolph, G.D., Laughon, M.M. et al. (2003) Integrating improvement competencies into residency education: A pilot project from a pediatric continuity clinic. Ambulatory Pediatrics 3(3): 131-136	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Monreal Perez, M. and Beltran Viciano, M.A. (2019) Educational intervention for achieving improvements in the vaccination coverage of meningitis C in primary care. Vacunas 20(1): 25-33	- Study not reported in English
Moretti, Manuel, Grill, Eva, Weitkunat, Rolf et al. (2003) An individualized telephone intervention to increase the immunization rates of school beginners. Zeitschrift fur Gesundheitspsychologie 11(2): 39-48	- Not a peer-reviewed publication
Morgan JL, Baggari SR, Chung W et al. (2015) Association of a Best-Practice Alert and Prenatal Administration With Tetanus Toxoid, Reduced Diphtheria Toxoid, and Acellular Pertussis Vaccination Rates. Obstetrics and gynecology 126(2): 333-337	- Comparator in study does not match that specified in protocol *The control cohort was usual care vaccinations during the post-partum period*

Study	Reason for exclusion
Morris, J, Wang, W, Wang, L et al. (2015) Comparison of reminder methods in selected adolescents with records in an immunization registry. Journal of adolescent health 56(5): S27-S32	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Moss, J.L., Gilkey, M.B., Griffith, T. et al. (2013) Organizational correlates of adolescent immunization: Findings of a state-wide study of primary care clinics in North Carolina. Vaccine 31(40): 4436-4441	- Not a relevant study design *Survey with no specific intervention.*
Moss, Jennifer L (2016) Concomitant adolescent vaccination: The influence of seasonal variation, school requirements, and patient-provider communication. Dissertation Abstracts International: Section B: The Sciences and Engineering 76(9be): no-specified	- Conference abstract
Moss, Jennifer L, Reiter, Paul L, Dayton, Amanda et al. (2012) Increasing adolescent immunization by webinar: a brief provider intervention at federally qualified health centers. Vaccine 30(33): 4960-3	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Moss, Jennifer L, Reiter, Paul L, Truong, Young K et al. (2016) School Entry Requirements and Coverage of Nontargeted Adolescent Vaccines. Pediatrics 138(6)	- Data not reported in an extractable format *Number of participants within states not provided.*
Muehleisen, Beda, Baer, Gurli, Schaad, Urs B et al. (2007) Assessment of immunization status in hospitalized children followed by counseling of parents and primary care physicians improves vaccination coverage: an interventional study. The Journal of pediatrics 151(6): 704-2	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Murphy, A W, Harrington, M, Bury, G et al. (1996) Impact of a collaborative immunisation programme in an inner city practice. Irish medical journal 89(6): 220-1	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Murray, K., Low, C., O'Rourke, A. et al. (2020) A quality improvement intervention failed to significantly increase	- Infrastructure study. Excluded because there

Study	Reason for exclusion
pneumococcal and influenza vaccination rates in immunosuppressed inflammatory arthritis patients. Clinical Rheumatology 39(3): 747-754	was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Nace DA, Perera S, Handler SM et al. (2011) Increasing influenza and pneumococcal immunization rates in a nursing home network. Journal of the American Medical Directors Association 12(9): 678-684	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Nan X; Futerfas M; Ma Z (2017) Role of Narrative Perspective and Modality in the Persuasiveness of Public Service Advertisements Promoting HPV Vaccination. Health communication 32(3): 320-328	- The study did not report any of the outcomes specified in the protocol
NCT01719679 (2012) School Located Adolescent Vaccination Study. https://clinicaltrials.gov/show/NCT01719679	- Protocol for a future study *This is the protocol for Shlay 2015, which is considered in this evidence review.*
Ndiaye, Serigne M, Hopkins, David P, Shefer, Abigail M et al. (2005) Interventions to improve influenza, pneumococcal polysaccharide, and hepatitis B vaccination coverage among high-risk adults: a systematic review. American journal of preventive medicine 28(5suppl): 248-79	- Systematic review that does not include a relevant population *Review looks at several high risk groups of adults*
Neubrand, Tara P L, Breitkopf, Carmen Radecki, Rupp, Richard et al. (2009) Factors associated with completion of the human papillomavirus vaccine series. Clinical pediatrics 48(9): 966-9	- Not a relevant study design *This is a survey of women who had an HPV vaccination.*
Niccolai, Linda M and Hansen, Caitlin E (2015) Practice- and Community-Based Interventions to Increase Human Papillomavirus Vaccine Coverage: A Systematic Review. JAMA pediatrics 169(7): 686-92	- Systematic review used as source of primary studies

Study	Reason for exclusion
Nichol, K.L. (1998) Ten-year durability and success of an organized program to increase influenza and pneumococcal vaccination rates among high-risk adults. American Journal of Medicine 105(5): 385-392	- Does not contain an outcome of relevance to this review *Vaccination numbers based on outcome of patient survey*
Nour, Rawan (2019) A Systematic Review of Methods to Improve Attitudes Towards Childhood Vaccinations. Cureus 11(7): e5067	- Systematic review used as source of primary studies
Nowalk MP, Nutini J, Raymund M et al. (2012) Evaluation of a toolkit to introduce standing orders for influenza and pneumococcal vaccination in adults: a multimodal pilot project. Vaccine 30(41): 5978-5982	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Nowalk, Mary Patricia, Moehling, Krissy K, Zhang, Song et al. (2017) Using the 4 Pillars to increase vaccination among high-risk adults: who benefits?. The American journal of managed care 23(11): 651-655	- Secondary publication of an included study that does not provide any additional relevant information
Nwanodi, Oroma; Salisbury, Helen; Bay, Curtis (2017) Multimodal Counseling Interventions: Effect on Human Papilloma Virus Vaccination Acceptance. Healthcare (Basel, Switzerland) 5(4)	- Does not contain an outcome of relevance to this review
Nyhan, Brendan, Reifler, Jason, Richey, Sean et al. (2014) Effective messages in vaccine promotion: a randomized trial. Pediatrics 133(4): e835-42	- Does not contain an outcome of relevance to this review
O'Leary, S, Pyrzanowski, J, Lockhart, S et al. (2017) Impact of a provider communication training intervention on adolescent human papillomavirus vaccination: a cluster randomized, clinical trial. Open forum infectious diseases 4: S61	- Conference abstract
O'Leary, S, Wagner, N, Narwaney, K et al. (2017) Effectiveness of a web-based intervention to increase uptake of maternal vaccines. Open forum infectious diseases 4: S457	- Conference abstract
Odone, Anna, Ferrari, Antonio, Spagnoli, Francesca et al. (2015) Effectiveness of interventions that apply new media to improve	- More recent systematic review identified that covers the same topic

Study	Reason for exclusion
vaccine uptake and vaccine coverage. Human vaccines & immunotherapeutics 11(1): 72-82	
Oeffinger, K C, Roaten, S P, Hitchcock, M A et al. (1992) The effect of patient education on pediatric immunization rates. The Journal of family practice 35(3): 288-93	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review *Participants were randomised by birth day of the week so not true randomisation.*
Ogilvie, G., Anderson, M., Marra, F. et al. (2010) A population-based evaluation of a publicly funded, school-based HPV vaccine program in British Columbia, Canada: Parental factors associated with HPV vaccine receipt. PLoS Medicine 7(5)	- Not a relevant study design *This study is a survey that looks at associations and risk factors for vaccine uptake.*
Okwo-Bele, J.M. (2012) Integrating immunization with other health interventions for greater impact: The right strategic choice. Journal of Infectious Diseases 205(suppl1): 4-s5	- Review article but not a systematic review
Oliver, Kristin; Frawley, Alean; Garland, Elizabeth (2016) HPV vaccination: Population approaches for improving rates. Human vaccines & immunotherapeutics 12(6): 1589-93	- Review article but not a systematic review *Article is assessing the evidence to support American vaccination recommendations.*
Opel, D.J., Henrikson, N., Lepere, K. et al. (2019) Previsit screening for parental vaccine hesitancy: A cluster randomized trial. Pediatrics 144(5): e20190802	- Study does not contain an intervention aimed at increasing vaccine uptake
Orefice, Roberto and Quinlivan, Julie A (2019) Small interface changes have dramatic impacts: how mandatory fields in electronic medical records increased pertussis vaccination rates in Australian obstetric patients. BMJ health & care informatics 26(1): 0	- Study does not contain an intervention aimed at increasing vaccine uptake

Study	Reason for exclusion
Ornstein, S M, Garr, D R, Jenkins, R G et al. (1991) Computer-generated physician and patient reminders. Tools to improve population adherence to selected preventive services. The Journal of family practice 32(1): 82-90	- Vaccine on UK routine schedule but wrong context for administration *This study is about tetanus immunisation that occurs every 10 years after the primary immunisation series.*
Ortega, A.N., Andrews, S.F., Katz, S.H. et al. (1997) Comparing a computer-based childhood vaccination registry with parental vaccination cards: A population-based study of Delaware children. Clinical Pediatrics 36(4): 217-221	- Study does not contain an intervention aimed at increasing vaccine uptake *This study compares the accuracy of 2 different record keeping systems.*
Ortiz, Rebecca R, Shafer, Autumn, Cates, Joan et al. (2018) Development and Evaluation of a Social Media Health Intervention to Improve Adolescents' Knowledge About and Vaccination Against the Human Papillomavirus. Global pediatric health 5: 2333794x18777918	- Does not contain an outcome of relevance to this review
Ortiz, Rebecca R; Smith, Andrea; Coyne-Beasley, Tamera (2019) A systematic literature review to examine the potential for social media to impact HPV vaccine uptake and awareness, knowledge, and attitudes about HPV and HPV vaccination. Human vaccines & immunotherapeutics 15(78): 1465-1475	- Systematic review used as source of primary studies
Pahud, B., Clark, S., Herigon, J.C. et al. (2015) A pilot program to improve vaccination status for hospitalized children. Hospital Pediatrics 5(1): 35-41	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Palmeri, S, Costantino, C, D'Angelo, C et al. (2017) HPV vaccine hesitancy among parents of female adolescents: a pre–post interventional study. Public Health 150: 84	- Does not contain an outcome of relevance to this review
Pandolfi, Elisabetta, Graziani, Maria C, Ieraci, Roberto et al. (2008) A comparison of populations vaccinated in a public service and in a private hospital setting in the same area. BMC public health 8: 278	- Study does not contain an intervention aimed at increasing vaccine uptake

Study	Reason for exclusion
Parker, Siddhartha, Chambers White, Laura, Spangler, Chad et al. (2013) A quality improvement project significantly increased the vaccination rate for immunosuppressed patients with IBD. Inflammatory bowel diseases 19(9): 1809-14	- Study does not include a relevant population *Furthermore, the age of the participants was not provided.*
Parra-Medina, Deborah, Morales-Campos, Daisy Y, Mojica, Cynthia et al. (2015) Promotora Outreach, Education and Navigation Support for HPV Vaccination to Hispanic Women with Unvaccinated Daughters. Journal of cancer education : the official journal of the American Association for Cancer Education 30(2): 353-9	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Parsons, Joanne E; Newby, Katie V; French, David P (2018) Do interventions containing risk messages increase risk appraisal and the subsequent vaccination intentions and uptake? - A systematic review and meta-analysis. British journal of health psychology 23(4): 1084-1106	- Systematic review used as source of primary studies
Patel, A., Stern, L., Unger, Z. et al. (2014) Staying on track: A cluster randomized controlled trial of automated reminders aimed at increasing human papillomavirus vaccine completion. Vaccine 32(21): 2428-2433	- Vaccine on UK routine schedule but wrong context for administration *The women in this study are aged 19 to 26 years (mean age 23 years).*
Patel, Anik R; Breck, Andrew B; Law, Michael R (2018) The impact of pharmacy-based immunization services on the likelihood of immunization in the United States. Journal of the American Pharmacists Association : JAPhA 58(5): 505-514e2	- Not a relevant study design
Paunio M, Virtanen M, Peltola H et al. (1991) Increase of vaccination coverage by mass media and individual approach: intensified measles, mumps, and rubella prevention program in Finland. American journal of epidemiology 133(11): 1152-1160	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Pereira, Jennifer A, Quach, Susan, Heidebrecht, Christine L et al. (2012) Barriers to the use of reminder/recall interventions for immunizations: a systematic review. BMC medical informatics and decision making 12: 145	- Qualitative systematic review
Perkins, Rebecca B, Legler, Aaron, Jansen, Emily et al. (2020) Improving HPV Vaccination Rates: A Stepped-Wedge Randomized Trial. Pediatrics 146(1)	- Education non-RCT. Excluded because there

Study	Reason for exclusion
	was sufficient RCT evidence for this review
Perkins, Rebecca B, Lin, Mengyun, Silliman, Rebecca A et al. (2015) Why are U.S. girls getting meningococcal but not human papilloma virus vaccines? Comparison of factors associated with human papilloma virus and meningococcal vaccination among adolescent girls 2008 to 2012. Women's health issues : official publication of the Jacobs Institute of Women's Health 25(2): 97-104	- Not a relevant study design
Perman, Sarah, Turner, Simon, Ramsay, Angus I G et al. (2017) School-based vaccination programmes: a systematic review of the evidence on organisation and delivery in high income countries. BMC public health 17(1): 252	- Systematic review that does not include the outcomes stated in the protocol
Pich, Jacqueline (2019) Patient reminder and recall interventions to improve immunization rates: A Cochrane review summary. International Journal of Nursing Studies 91: 144	- Review article but not a systematic review *Summary of a Cochrane systematic review*
Piedimonte, S, Leung, A, Zakhari, A et al. (2018) Impact of an HPV Education and Vaccination Campaign among Canadian University Students. Journal of obstetrics and gynaecology canada 40(4): 440-446	- Study participants are the wrong age group *The subjects are university students, not teenagers.*
Pierre-Victor, Dudith, Page, Timothy F, Trepka, Mary Jo et al. (2017) Impact of Virginia's School-Entry Vaccine Mandate on Human Papillomavirus Vaccination Among 13-17-Year-Old Females. Journal of women's health (2002) 26(3): 266-275	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Poole, Tracey, Goodyear-Smith, Felicity, Petousis-Harris, Helen et al. (2012) Human papillomavirus vaccination in Auckland: reducing ethnic and socioeconomic inequities. Vaccine 31(1): 84-8	- Not a relevant study design *This study is a survey*

Study	Reason for exclusion
Porter RM, Amin AB, Bednarczyk RA et al. Cancer-salient messaging for Human Papillomavirus vaccine uptake: A randomized controlled trial. Vaccine 36(18): 2494-2500	- The study did not report any of the outcomes specified in the protocol
Porter, A.M. and Fulco, P.P. (2020) Impact of a pharmacist-driven recombinant zoster vaccine administration program. Journal of the American Pharmacists Association	- Study does not include a relevant population *Furthermore, the age of the participants was not provided.*
Poscia, Andrea, Pastorino, Roberta, Boccia, Stefania et al. (2019) The impact of a school-based multicomponent intervention for promoting vaccine uptake in Italian adolescents: a retrospective cohort study. Annali dell'Istituto superiore di sanita 55(2): 124-130	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Pot, M., Paulussen, T.G., Ruiter, R.A. et al. (2020) Dose-Response Relationship of a Web-Based Tailored Intervention Promoting Human Papillomavirus Vaccination: Process Evaluation of a Randomized Controlled Trial. Journal of medical Internet research 22(7): e14822	- Duplicate reference *This is a process evaluation of Pot 2017, which has been assessed in this evidence review.*
Pot, Mirjam, Ruiter, Robert A C, Paulussen, Theo W G M et al. (2018) Systematically Developing a Web-Based Tailored Intervention Promoting HPV-Vaccination Acceptability Among Mothers of Invited Girls Using Intervention Mapping. Frontiers in public health 6: 226	- Does not contain an outcome of relevance to this review
Quinley, John C and Shih, Anthony (2004) Improving physician coverage of pneumococcal vaccine: a randomized trial of a telephone intervention. Journal of community health 29(2): 103-15	- Data not reported in an extractable format *Participant numbers were not provided.*
Rabarison, Kristina M, Li, Rui, Bish, Connie L et al. (2015) A Cost Analysis of the 1-2-3 Pap Intervention. Frontiers in public health services & systems research 4(4): 45-50	- Not a relevant study design *Cost-effectiveness analysis only*

Study	Reason for exclusion
Ramón Esparza, T; Hernando Arizaleta, L; García Calvente, MM (1990) Vaccination every time when an occasion arises: evaluation of an intervention in the Murcia Autonomous Community. Atencion primaria / Sociedad Espanola de Medicina de Familia y Comunitaria 7(10): 616-621	- Study not reported in English
Rangrej, MI (2017) IMPACT OF CLINICAL PHARMACIST INTERVENTION ON THE KNOWLEDGE OF IMMUNIZATION IN PARENTS OF PEDIATRICS IN TERTIARY CARE HOSPITAL. Value in Health : The Journal of the International Society for Pharmacoeconomics and Outcomes Research 20(5)	- Conference abstract
Rani, U., Darabaner, E., Seserman, M. et al. (2020) Public Education Interventions and Uptake of Human Papillomavirus Vaccine: A Systematic Review. Journal of public health management and practice : JPHMP	- Systematic review used as source of primary studies
Raviotta, Jonathan Marc (2020) The development testing and implementation of the 4 pillarsTM practice transformation program for immunization: Achieving public health outcomes through primary care quality improvement. Dissertation Abstracts International: Section B: The Sciences and Engineering 81(8b): no-specified	- Review article but not a systematic review
Reading, Richard (2009) Pediatric primary care to help prevent child maltreatment: the Safe Environment for Every Kid (SEEK) model. Child Care, Health and Development 35(4): 588	- Not a peer-reviewed publication *This is an editorial about Dubowitz 2009, which has been considered in this review.*
Redfield, J.R. and Wang, T.W. (2000) Improving pneumococcal vaccination rates: A three-step approach. Family Medicine 32(5): 338-341	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Reiter, Paul L, Stubbs, Brenda, Panozzo, Catherine A et al. (2011) HPV and HPV vaccine education intervention: effects on parents, healthcare staff, and school staff. Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology 20(11): 2354-61	- Does not contain an outcome of relevance to this review
Reno, Jenna E, Thomas, Jacob, Pyrzanowski, Jennifer et al. (2019) Examining strategies for improving healthcare providers' communication about adolescent HPV vaccination: evaluation of secondary outcomes in a randomized controlled trial. Human vaccines & immunotherapeutics 15(78): 1592-1598	- Duplicate reference *This is a survey following a study that has already been included: Dempsey 2018:*

Study	Reason for exclusion
	Effect of a Health Care Professional Communication Training Intervention on Adolescent Human Papillomavirus Vaccination: A Cluster Randomized Clinical Trial
Ressler KA, Orr K, Bowdler S et al. (2008) Opportunistic immunisation of infants admitted to hospital: are we doing enough?. Journal of paediatrics and child health 44(6): 317-320	- Study describes a catch up campaign following the introduction of a vaccine- out of scope of the review
Reuben, D.B., Hirsch, S.H., Frank, J.C. et al. (1996) The prevention for elderly persons (PEP) program: A model of municipal and academic partnership to meet the needs of older persons for preventive services. Journal of the American Geriatrics Society 44(11): 1394-1398	- The study did not report any of the outcomes specified in the protocol
Richman, Alice R, Maddy, LaDonna, Torres, Essie et al. (2016) A randomized intervention study to evaluate whether electronic messaging can increase human papillomavirus vaccine completion and knowledge among college students. Journal of American college health : J of ACH 64(4): 269-78	- Study participants are the wrong age group *Adults aged 18-26 for HPV vaccination*
Rickert, Donna, Deladisma, Adeline, Yusuf, Hussain et al. (2004) Adolescent immunizations. are we ready for a new wave?. American journal of preventive medicine 26(1): 22-8	- Not a relevant study design *Survey that looks at associations and risk factors for uptake.*
Rickert, Vaughn I, Auslander, Beth A, Cox, Dena S et al. (2015) School-based HPV immunization of young adolescents: effects of two brief health interventions. Human vaccines & immunotherapeutics 11(2): 315-21	- Does not contain an outcome of relevance to this review *Vaccination intent is recorded for each of the 4 arms but not uptake. Percentage uptake is recorded for all 4 arms together but not for each arm separately.*

Study	Reason for exclusion
Ridda, Iman, MacIntyre, Raina C, Lindley, Richard I et al. (2007) Predictors of pneumococcal vaccination uptake in hospitalized patients aged 65 years and over shortly following the commencement of a publicly funded national pneumococcal vaccination program in Australia. Human vaccines 3(3): 83-6	- The intervention is a free vaccine- not in scope
Righolt, Christiaan H; Bozat-Emre, Songul; Mahmud, Salaheddin M (2019) Effectiveness of school-based and high-risk human papillomavirus vaccination programs against cervical dysplasia in Manitoba, Canada. International journal of cancer 145(3): 671-677	- Does not contain an outcome of relevance to this review
Rihtarchik, Lindsey, Murphy, Claire V, Porter, Kyle et al. (2018) Utilizing pharmacy intervention in asplenic patients to improve vaccination rates. Research in social & administrative pharmacy : RSAP 14(4): 367-371	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review
Riley R; Maher C; Kolbe A (1993) Hepatitis B vaccination of high-risk neonates in the South West Region of New South Wales: evaluation of program coverage. Australian journal of public health 17(2): 171-173	- Not a relevant study design *Study does not have a comparison group.*
Riley, D.J.; Mughal, M.Z.; Roland, J. (1991) Immunisation state of young children admitted to hospital and effectiveness of a ward based opportunistic immunisation policy. British Medical Journal 302(6767): 31-33	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Rimple, Diane, Weiss, Steven J, Brett, Meghan et al. (2006) An emergency department-based vaccination program: overcoming the barriers for adults at high risk for vaccine-preventable diseases. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine 13(9): 922-30	- Study does not include a relevant population
Rizzo, C. (2006) Improving immunization rates in practice settings. Pediatric Annals 35(7): 493-497	- Review article but not a systematic review
Robare, Joseph F, Bayles, Constance M, Newman, Anne B et al. (2011) The "10 Keys" to Healthy Aging: 24-Month Follow-Up Results From an Innovative Community-Based Prevention Program. Health Education & Behavior 38(4): 379-388	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Robison, Steve G (2013) Sick-visit immunizations and delayed well-baby visits. Pediatrics 132(1): 44-8	- Data not reported in an extractable format *The data that we would like was written in a narrative rather than numerical format.*
Rockliffe L, Chorley AJ, McBride E et al. Assessing the acceptability of incentivising HPV vaccination consent form return as a means of increasing uptake. BMC public health 18(1): 382	- The study did not report any of the outcomes specified in the protocol
Rosberger Z, Krawczyk A, Stephenson E et al. (2014) HPV vaccine education: enhancing knowledge and attitudes of community counselors and educators. Journal of cancer education : the official journal of the American Association for Cancer Education 29(3): 473-477	- The study did not report any of the outcomes specified in the protocol
Rosen, Brittany L, Bishop, James M, McDonald, Skye L et al. (2018) Quality of Web-Based Educational Interventions for Clinicians on Human Papillomavirus Vaccine: Content and Usability Assessment. JMIR cancer 4(1): e3	- Systematic review that does not include the outcomes stated in the protocol
Rosenberg, Karen (2019) EDUCATIONAL INTERVENTION IMPROVES VACCINATION RATES IN OLDER PATIENTS. The American Journal of Nursing 119(7): 63	- Review article but not a systematic review
Rosenberg, Karen (2014) AFIX CONSULTATIONS MAY INCREASE VACCINATION COVERAGE IN YOUNGER ADOLESCENTS. The American Journal of Nursing 114(11): 65	- Not a peer-reviewed publication *Editorial about a study that has already been considered in this review: Gilkey 2014: Increasing provision of adolescent vaccines in primary care: a randomized controlled trial*
Rosenberg, Z, Findley, S, McPhillips, S et al. (1995) Community-based strategies for immunizing the "hard-to-reach" child: the New York State immunization and primary health care initiative. American journal of preventive medicine 11(3suppl): 14-20	- Study does not contain an intervention aimed at increasing vaccine uptake

Study	Reason for exclusion
Rosser, W W; McDowell, I; Newell, C (1991) Use of reminders for preventive procedures in family medicine. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 145(7): 807-14	- The study did not report any of the outcomes specified in the protocol *Tetanus vaccination is not on routine schedule after age 18 in UK and flu vaccination is not covered by this guideline*
Ruffin, Mack T 4th, Plegue, Melissa A, Rockwell, Pamela G et al. (2015) Impact of an Electronic Health Record (EHR) Reminder on Human Papillomavirus (HPV) Vaccine Initiation and Timely Completion. Journal of the American Board of Family Medicine : JABFM 28(3): 324-33	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Ruiz-López T, Sen S, Jakobsen E et al. (2019) FightHPV: Design and Evaluation of a Mobile Game to Raise Awareness About Human Papillomavirus and Nudge People to Take Action Against Cervical Cancer. JMIR serious games 7(2): e8540	- The study did not report any of the outcomes specified in the protocol
Russell, SL (2012) Effectiveness of text message reminders for improving vaccination appointment attendance and series completion among adolescents and adults. Value in health 15(4): A248	- Conference abstract
Sadaf A, Richards JL, Glanz J, Salmon DA, Omer SB (2013) A systematic review of interventions for reducing parental vaccine refusal and vaccine hesitancy. Vaccine 31(40): 4293-4304	- Systematic review used as source of primary studies
Saeterdal, Ingvil, Lewin, Simon, Austvoll-Dahlgren, Astrid et al. (2014) Interventions aimed at communities to inform and/or educate about early childhood vaccination. The Cochrane database of systematic reviews: cd010232	- Systematic review used as source of primary studies
Saffin K (1992) School nurses immunising without a doctor present. Health visitor 65(11): 394-396	- Does not contain an outcome of relevance to this review *This is a survey of nurses' opinions.*
Saito, A, Saitoh, A, Sato, I et al. (2016) Effectiveness of stepwise perinatal immunization education: a cluster randomized controlled trial. Open forum infectious diseases 3	- Conference abstract

Study	Reason for exclusion
Santa Maria, Diane (2020) EFFICACY OF A STUDENT-NURSE BRIEF PARENT-BASED SEXUAL HEALTH INTERVENTION TO INCREASE HPV VACCINATION AMONG ADOLESCENTS. Journal of Adolescent Health 66(2s)	- Conference abstract
Schempf, A.H.; Politzer, R.M.; Wulu, J. (2003) Immunization coverage of vulnerable children: A comparison of health center and national rates. Medical Care Research and Review 60(1): 85-100	- Study does not contain an intervention aimed at increasing vaccine uptake
Seib K, Underwood NL, Gargano LM et al. (2016) Preexisting Chronic Health Conditions and Health Insurance Status Associated With Vaccine Receipt Among Adolescents. The Journal of adolescent health : official publication of the Society for Adolescent Medicine 58(2): 148-153	- Does not contain an outcome of relevance to this review *This study does not measure uptake for each of the 3 arms.*
Seib, KG, Herbert, N, Gargano, L et al. (2014) Pre-existing chronic health conditions and health insurance status as determinants of vaccine receipt among adolescents in Richmond county, Georgia. Journal of adolescent health 54(2): S29	- Conference abstract
Sellors, J, Pickard, L, Mahony, J B et al. (1997) Understanding and enhancing compliance with the second dose of hepatitis B vaccine: a cohort analysis and a randomized controlled trial. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 157(2): 143-8	- Study participants are the wrong age group *This study looks at HepB vaccination for adults.*
Sewell, M.J., Riche, D.M., Fleming, J.W. et al. (2016) Comparison of pharmacist and physician managed annual medicare wellness services. Journal of Managed Care and Specialty Pharmacy 22(12): 1412-1416	- Study does not contain an intervention aimed at increasing vaccine uptake
Shah, M.D., Glenn, B.A., Chang, L.C. et al. (2020) Reducing Missed Opportunities for Human Papillomavirus Vaccination in School-Based Health Centers: Impact of an Intervention. Academic Pediatrics	- Does not contain an outcome of relevance to this review *This study looks at missed opportunities, not vaccine uptake*
Shah, MN, Clarkson, L, Lerner, EB et al. (2006) An emergency medical services program to promote the health of older adults. Journal of the american geriatrics society 54(6): 956-962	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Shaw, J., Mader, E.M., Bennett, B.E. et al. (2018) Immunization mandates, vaccination coverage, and exemption rates in the United States. Open Forum Infectious Diseases 5(6)	- Not a relevant study design *Survey that looks at associations and risk factors for vaccination*
Shaw, J.S., Samuels, R.C., Larusso, E.M. et al. (2000) Impact of an encounter-based prompting system on resident vaccine administration performance and immunization knowledge. Pediatrics 105(4ii): 978-983	- The study did not report any of the outcomes specified in the protocol *Study looks at missed opportinities and prescribing errors, not vaccine uptake*
Shay, L Aubree, Street, Richard L Jr, Baldwin, Austin S et al. (2016) Characterizing safety-net providers' HPV vaccine recommendations to undecided parents: A pilot study. Patient education and counseling 99(9): 1452-60	- The study did not report any of the outcomes specified in the protocol *There is no intervention - this is a conversation analysis of consultations*
Sheaves, Crystal (2016) Evaluating changes in knowledge, beliefs, and behaviors associated with HPV following an educational intervention among women. Dissertation Abstracts International: Section B: The Sciences and Engineering 76(12be): no-specified	- Not a peer-reviewed publication
Shenson, D., Adams, M., Bolen, J. et al. (2011) Routine checkups don't ensure that seniors get preventive services. The Journal of family practice 60(1): e1-e10	- Not a relevant study design *This is a survey that looks for associations and risk factors for vaccination*
Shlay JC, Rodgers S, Lyons J et al. (2015) Implementing a School-Located Vaccination Program in Denver Public Schools. The Journal of school health 85(8): 536-543	- The study did not report any of the outcomes specified in the protocol
Si, Mingyu, Su, Xiaoyou, Jiang, Yu et al. (2019) Interventions to improve human papillomavirus vaccination among Chinese female	- Protocol for a future study

Study	Reason for exclusion
college students: study protocol for a randomized controlled trial. BMC public health 19(1): 1546	
Siebers, M J and Hunt, V B (1985) Increasing the pneumococcal vaccination rate of elderly patients in a general internal medicine clinic. Journal of the American Geriatrics Society 33(3): 175-8	- Study published before 1990 date limit set in review protocol
Singh, S.; Mazor, K.M.; Fisher, K.A. (2019) Positive deviance approaches to improving vaccination coverage rates within healthcare systems: A systematic review. Journal of Comparative Effectiveness Research 8(13): 1055-1065	- Systematic review that does not include relevant study types
Sinn JS; Morrow AL; Finch AB (1999) Improving immunization rates in private pediatric practices through physician leadership. Archives of pediatrics & adolescent medicine 153(6): 597-603	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review *This was a before-and-after study.*
Siriwardena, A.N., Rashid, A., Johnson, M.R.D. et al. (2002) Cluster randomised controlled trial of an educational outreach visit to improve influenza and pneumococcal immunisation rates in primary care. British Journal of General Practice 52(482): 735-740	- Study does not include a relevant population *The intervention is provider education. The ≥65 years of age population for influenza vaccine (n=27,580) was different to the populations for pneumonia vaccine. The populations for pneumonia vaccine were people with: congestive heart disease (n=6207), diabetes (n=4327) and splenectomy (n=169).*
Skedgel C, Langley JM, MacDonald NE et al. (2011) An incremental economic evaluation of targeted and universal influenza vaccination in pregnant women. Canadian journal of public health = Revue canadienne de sante publique 102(6): 445-450	- Does not contain an outcome of relevance to this review *Study does not have vaccine uptake data, it looks at whether people should be vaccinated or not.*

Study	Reason for exclusion
Skinner, S R, Imberger, A, Nolan, T et al. (2000) Randomised controlled trial of an educational strategy to increase school-based adolescent hepatitis B vaccination. Australian and New Zealand journal of public health 24(3): 298-304	- Vaccine on UK routine schedule but wrong context for administration *HepB vaccine is given to infants in the UK, not teenagers.*
Skinner, SR, Davies, C, Cooper, S et al. (2015) Randomised controlled trial of a complex intervention to improve school-based HPV vaccination for adolescents: the HPV. EDU study. Sexually transmitted infections 91: A77	- Conference abstract
Skledar SJ, Hess MM, Ervin KA et al. (2003) Designing a hospital-based pneumococcal vaccination program. American journal of health-system pharmacy : AJHP : official journal of the American Society of Health-System Pharmacists 60(14): 1471-1476	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Smith, J.M. and Craig, T.J. (2006) Strategies for improving pneumococcal vaccination in eligible patients. Current Infectious Disease Reports 8(3): 231-237	- Review article but not a systematic review
Smith, Kenneth J, Zimmerman, Richard K, Nowalk, Mary Patricia et al. (2017) Cost-Effectiveness of the 4 Pillars Practice Transformation Program to Improve Vaccination of Adults Aged 65 and Older. Journal of the American Geriatrics Society 65(4): 763-768	- Duplicate reference *This is an economic analysis of a study already considered in this review: Zimmerman 2017: Using the 4 Pillars Practice Transformation Program to Increase Pneumococcal Immunizations for Older Adults: a Cluster-Randomized Trial*
Smulian, Elizabeth A; Mitchell, Krista R; Stokley, Shannon (2016) Interventions to increase HPV vaccination coverage: A systematic review. Human vaccines & immunotherapeutics 12(6): 1566-88	- Systematic review used as source of primary studies
Sohn, M.-W., Yoo, J., Oh, E.H. et al. (2011) Welfare, maternal work, and on-time childhood vaccination rates. Pediatrics 128(6): 1109-1116	- Not a relevant study design *This study retrospectively selects factors that may increase vaccine uptake as*

Study	Reason for exclusion
	if they were 'risk factors' for vaccine uptake.
Soljak, M A and Handford, S (1987) Early results from the Northland immunisation register. The New Zealand medical journal 100(822): 244-6	- Study published before 1990 date limit set in review protocol
Soon, Reni, Sung, Stephen, Cruz, May Rose Dela et al. (2017) Improving Human Papillomavirus (HPV) Vaccination in the Postpartum Setting. Journal of community health 42(1): 66-71	- Study participants are the wrong age group *Participants were of university age, not teenagers at school.*
Srivastava, T.; Emmer, K.; Feemster, K.A. (2020) Impact of school-entry vaccination requirement changes on clinical practice implementation and adolescent vaccination rates in metropolitan Philadelphia. Human Vaccines and Immunotherapeutics 16(5): 1155-1165	- The study did not report any of the outcomes specified in the protocol
Stanwyck, C.A.; Kolasa, M.S.; Shaw, K.M. (2004) Immunization requirements for childcare programs: Are they enough?. American Journal of Preventive Medicine 27(2): 161-163	- Not a relevant study design *This study is a survey that looks at factors associated with vaccination. There is no specific intervention to increase uptake.*
Staras, S.A.S., Richardson, E., Merlo, L.J. et al. (2021) A feasibility trial of parent HPV vaccine reminders and phone-based motivational interviewing. BMC public health 21(1): 109	- Does not contain an outcome of relevance to this review *The outcome was acceptability, not uptake.*
Staras, SA, Vadaparampil, S, Livingston, IM et al. (2014) A health information technology intervention increases HPV vaccine series initiation among Florida Medicaid and CHIP adolescents. Sexually transmitted diseases 41(suppl1): S9-10	- Conference abstract
Staras, SAS, Vadaparampil, ST, Thompson, LA et al. (2020) Postcard reminders for HPV vaccination mainly primed parents for providers' recommendations. Preventive medicine reports 20	- Does not contain an outcome of relevance to this review

Study	Reason for exclusion
	This is a secondary analysis of a previous study (Staras 2015) and does not report vaccine uptake for each intervention. The previous study was quasi-experimental but this evidence review is at the RCT and cluster RCT level of evidence.
Staras, Stephanie A S, Vadaparampil, Susan T, Livingston, Melvin D et al. (2015) Increasing human papillomavirus vaccine initiation among publicly insured Florida adolescents. The Journal of adolescent health : official publication of the Society for Adolescent Medicine 56(5suppl): 40-6	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Stevens, B. and Gibbins, S. (2002) Immunizations in adulthood. Primary Care - Clinics in Office Practice 29(3): 649-665	- Review article but not a systematic review
Stevenson, K B, McMahon, J W, Harris, J et al. (2000) Increasing pneumococcal vaccination rates among residents of long-term--care facilities: provider-based improvement strategies implemented by peer-review organizations in four western states. Infection control and hospital epidemiology 21(11): 705-10	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Stille, C J, Christison-Lagay, J, Bernstein, B A et al. (2001) A simple provider-based educational intervention to boost infant immunization rates: a controlled trial. Clinical pediatrics 40(7): 365-73	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Stockwell, Melissa S, Kharbanda, Elyse Olshen, Martinez, Raquel Andres et al. (2012) Text4Health: impact of text message reminder-recalls for pediatric and adolescent immunizations. American journal of public health 102(2): e15-21	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Stone, Erin G, Morton, Sally C, Hulscher, Marlies E et al. (2002) Interventions that increase use of adult immunization and cancer screening services: a meta-analysis. Annals of internal medicine 136(9): 641-51	- More recent systematic review identified that covers the same topic *Interventions to increase adult immunisation covered by other SRs while cancer*

Study	Reason for exclusion
	screening is not within the scope of this review.
Stroffolini T and Pasquini P (1990) Five years of vaccination campaign against hepatitis B in Italy in infants of hepatitis B surface antigen carrier mothers. The Italian journal of gastroenterology 22(4): 195-197	- Study does not contain an intervention aimed at increasing vaccine uptake *This study is mostly about screening pregnant women for HBsAg. Yearly changes in HepB uptake are looked at in a coincidental way.*
Sumner, W. (1991) Brief reports. An evaluation of readable preventive health messages. Family Medicine 23(6): 463-6	- Vaccine on UK routine schedule but wrong context for administration *Mean age of participants was 35 to 38 years with SD 10.7 to 13.2 for the 3 study groups. This age group is not on the routine vaccination schedule.*
Suppli, Camilla Hiul, Rasmussen, Mette, Valentiner-Branth, Palle et al. (2017) Written reminders increase vaccine coverage in Danish children - evaluation of a nationwide intervention using The Danish Vaccination Register, 2014 to 2015. Euro surveillance : bulletin Europeen sur les maladies transmissibles = European communicable disease bulletin 22(17)	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Suryadevara M, Bonville CA, Ferraioli F et al. (2013) Community-centered education improves vaccination rates in children from low-income households. Pediatrics 132(2): 319-325	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Szczerbinska, K., Topinkova, E., Brzyski, P. et al. (2016) Delivery of Care to Nursing Home Residents With Diabetes: Results From the SHELTER Study. Journal of the American Medical Directors Association 17(9): 807-813	- Study does not contain an intervention aimed at increasing vaccine uptake *Study looks at factors associated with vaccination*
Taddio, Anna, Alderman, Leslie, Freedman, Tamlyn et al. (2019) The CARD™ System for improving the vaccination experience at	- Study includes data on a vaccine that is not on the

Study	Reason for exclusion
school: Results of a small-scale implementation project on program delivery. Paediatrics & Child Health 24: 54-s67	UK routine vaccination schedule *Study includes HepB vaccine for adolescents and it is not possible to separate out the data for HPV vaccine.*
Taitel, M.S., Fensterheim, L.E., Cannon, A.E. et al. (2013) Improving pneumococcal and herpes zoster vaccination uptake: Expanding pharmacist privileges. American Journal of Managed Care 19(9): e309-e313	- Not a relevant study design *This study has selected characteristics of a population and has treated them as 'risk factors' for vaccine uptake.*
Takayama, J I; Iser, J P; Gandelman, A (1999) Regional differences in infant immunization against hepatitis B: did intervention work?. Preventive medicine 28(2): 160-6	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Tayfur, I.; Gunaydin, M.; Suner, S. (2019) Healthcare service access and utilization among syrian refugees in Turkey. Annals of Global Health 85(1): 42	- Not a relevant study design *This is a survey that looks at factors associated with vaccination.*
Taylor, J.A., Rietberg, K., Greenfield, L. et al. (2008) Effectiveness of a physician peer educator in improving the quality of immunization services for young children in primary care practices. Vaccine 26(33): 4256-4261	- Data not reported in an extractable format *Data was given as percentages without participant numbers*
Thomas, D R, King, J, Evans, M R et al. (1998) Uptake of measles containing vaccines in the measles, mumps, and rubella second dose catch-up programme in Wales. Communicable disease and public health 1(1): 44-7	- Study looks at intervention in the context of introducing a new vaccine
Thomas, T.L.; Stephens, D.P.; Blanchard, B. (2010) Hip Hop, Health, and Human Papilloma Virus (HPV): Using Wireless	- Does not contain an outcome of relevance to this review

Study	Reason for exclusion
Technology to Increase HPV Vaccination Uptake. Journal for Nurse Practitioners 6(6): 464-470	
Thompson, E.L., Livingston, M.D., Daley, E.M. et al. (2020) Rhode Island Human Papillomavirus Vaccine School Entry Requirement Using Provider-Verified Report. American Journal of Preventive Medicine 59(2): 274-277	- Data not reported in an extractable format *Only percentage uptake was provided. Numbers of participants were not provided for each arm.*
Trethewey, Samuel P; Patel, Neil; Turner, Alice M (2019) Interventions to Increase the Rate of Influenza and Pneumococcal Vaccination in Patients with Chronic Obstructive Pulmonary Disease: A Scoping Review. Medicina (Kaunas, Lithuania) 55(6)	- Systematic review that does not include a relevant population *People with COPD*
Trick, William E, Linn, Edward S, Jones, Zina et al. (2010) Using computer decision support to increase maternal postpartum tetanus, diphtheria, and acellular pertussis vaccination. Obstetrics and gynecology 116(1): 51-7	- Study does not include a relevant population
Tubeuf S, Edlin R, Shourie S et al. (2014) Cost effectiveness of a web-based decision aid for parents deciding about MMR vaccination: a three-arm cluster randomised controlled trial in primary care. The British journal of general practice : the journal of the Royal College of General Practitioners 64(625): e493	- Secondary publication of an included study that does not provide any additional relevant information *This is a mirror publication of Shourie 2013. We have included Shourie 2013 in the review because it is a cluster RCT and reports the Intracluster Correlation Coefficient.*
Tyler, Darlene, Nyamathi, Adeline, Stein, Judith A et al. (2014) Increasing hepatitis C knowledge among homeless adults: results of a community-based, interdisciplinary intervention. The journal of behavioral health services & research 41(1): 37-49	- Does not contain an outcome of relevance to this review
Tyler, R., Kile, S., Strain, O. et al. (2020) Impact of pharmacist intervention on completion of recombinant zoster vaccine series in a community pharmacy. Journal of the American Pharmacists Association	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Underwood, Natasha L, Gargano, Lisa M, Jacobs, Samantha et al. (2016) Influence of Sources of Information and Parental Attitudes on Human Papillomavirus Vaccine Uptake among Adolescents. Journal of pediatric and adolescent gynecology 29(6): 617-622	- Secondary publication of an included study that does not provide any additional relevant information *This is a secondary publication of Underwood 2015, which is already considered in this review. Underwood 2015 does not have any further outcomes of interest for each of the 3 arms.*
Uskun, Ersin, Uskun, Suha Basar, Uysalgenc, Meral et al. (2008) Effectiveness of a training intervention on immunization to increase knowledge of primary healthcare workers and vaccination coverage rates. Public health 122(9): 949-58	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Vacek JL (2004) Practical strategies for cardiac disease prevention. Basic steps to ensure better heart health. Postgrad Med 3	- Review article but not a systematic review
Vacek, J.L. (2004) Practice-based continuing education combined with process improvement methods improves delivery of preventive services to children. Evidence-Based Healthcare 8(4): 177-179	- Duplicate reference *This is an editorial about Vacek 2004, which is considered in this review.*
Valdez, Armando, Stewart, Susan L, Tanjasiri, Sora Park et al. (2015) Design and efficacy of a multilingual, multicultural HPV vaccine education intervention. Journal of communication in healthcare 8(2): 106-118	- Does not contain an outcome of relevance to this review
Valeri, Fabio, Hatz, Christoph, Jordan, Dominique et al. (2014) Immunisation coverage of adults: a vaccination counselling campaign in the pharmacies in Switzerland. Swiss medical weekly 144: w13955	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Vanderpool, Robin C, Cohen, Elisia, Crosby, Richard A et al. (2013) "1-2-3 Pap" Intervention Improves HPV Vaccine Series Completion among Appalachian Women. The Journal of communication 63(1): 95-115	- Study participants are the wrong age group *Participants were aged 22 years (SD 2.4). The UK routine vaccination age*

Study	Reason for exclusion
	range for HPV vaccine is 11 to 18 years.
Varman, M, Sharlin, C, Fernandez, C et al. (2018) Human Papilloma Virus Vaccination Among Adolescents in a Community Clinic Before and After Intervention. Journal of community health 43(3): 455-458	- Review article but not a systematic review
Venkatesh, Ashwin, Chia, Daphne Theresa, Tang, Anthony et al. (2020) Efficacy of text message intervention for increasing MMR uptake in light of the recent loss of UK's measles-free status. The British Journal of General Practice : The Journal of the Royal College of General Practitioners 70(692): 110	- Review article but not a systematic review
Vondracek, T G; Pham, T P; Huycke, M M (1998) A hospital-based pharmacy intervention program for pneumococcal vaccination. Archives of internal medicine 158(14): 1543-7	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Wagner, Abram L, Shrivastwa, Nijika, Potter, Rachel C et al. (2018) Pneumococcal and Meningococcal Vaccination among Michigan Children with Sickle Cell Disease. The Journal of pediatrics 196: 223-229	- Study does not contain an intervention aimed at increasing vaccine uptake *This study compares vaccine uptake between children who have sickle cell disease and those who do not.*
Wagner, Nicole Marie (2019) Assessing the value of the vaccine social media intervention through the re-aim framework implementation dimension. Dissertation Abstracts International: Section B: The Sciences and Engineering 80(11be): no-specified	- Not a peer-reviewed publication
Wallace C; Leask J; Trevena LJ (2006) Effects of a web based decision aid on parental attitudes to MMR vaccination: a before and after study. BMJ (Clinical research ed.) 332(7534): 146-149	- The study did not report any of the outcomes specified in the protocol
Wallace, A.S.; Ryman, T.K.; Dietz, V. (2012) Experiences integrating delivery of maternal and child health services with childhood immunization programs: Systematic review update. Journal of Infectious Diseases 205(suppl1): 6-s19	- Systematic review used as source of primary studies

Study	Reason for exclusion
Wallgren, S.; Berry-Caban, C.S.; Bowers, L. (2012) Impact of Clinical Pharmacist Intervention on diabetes-Related outcomes in a military treatment Facility. Annals of Pharmacotherapy 46(3): 353-357	- Study does not contain an intervention aimed at increasing vaccine uptake *The intervention is aimed at managing diabetes and related conditions. There is no mention of an intervention specifically for vaccines.*
Walling, Emily B, Benzoni, Nicole, Dornfeld, Jarrod et al. (2016) Interventions to Improve HPV Vaccine Uptake: A Systematic Review. Pediatrics 138(1)	- Systematic review used as source of primary studies
Wang, Jiangrong, Ploner, Alexander, Sparen, Par et al. (2019) Mode of HPV vaccination delivery and equity in vaccine uptake: A nationwide cohort study. Preventive medicine 120: 26-33	- Not a relevant study design *Survey looking at factors that affect vaccine uptake.*
Wang, Junling, Ford, Lindsay J, Wingate, La'Marcus et al. (2013) Effect of pharmacist intervention on herpes zoster vaccination in community pharmacies. Journal of the American Pharmacists Association : JAPhA 53(1): 46-53	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Ward, K., Chow, M.Y.K., King, C. et al. (2012) Strategies to improve vaccination uptake in Australia, a systematic review of types and effectiveness. Australian and New Zealand Journal of Public Health 36(4): 369-377	- Systematic review used as source of primary studies
Weaver, M, Krieger, J, Castorina, J et al. (2001) Cost-effectiveness of combined outreach for the pneumococcal and influenza vaccines. Archives of internal medicine 161(1): 111-20	- Duplicate reference *This is an economic analysis of a study already considered in this review: Krieger 2000: Increasing influenza and pneumococcal immunization rates: a randomized controlled study of a senior center-based intervention*

Study	Reason for exclusion
Weir, Rosy Chang, Toyoji, Mariko, McKee, Michael et al. (2018) Assessing the Impact of Electronic Health Record Interventions on Hepatitis B Screening and Vaccination. Journal of health care for the poor and underserved 29(4): 1587-1605	- Study does not include a relevant population *Study look at HBV vaccination in Asian American adults who are at higher risk of HBV. Also vaccination not provided to adults routinely in UK.*
Wells, C., Monte, S.V., Prescott, W.A. et al. (2019) A pharmacy resident-driven pneumococcal vaccination protocol increases vaccination rates in hospitalized patients over 65 years. JACCP Journal of the American College of Clinical Pharmacy 2(5): 488-493	- Infrastructure study. Excluded because there was sufficient RCT and cohort evidence for this review
Westrick, Salisa C, Owen, James, Hagel, Harry et al. (2016) Impact of the RxVaccinate program for pharmacy-based pneumococcal immunization: A cluster-randomized controlled trial. Journal of the American Pharmacists Association : JAPhA 56(1): 29-36e1	- Data not reported in an extractable format *Data was given as percentages without participant numbers*
Whelan, Noella W, Steenbeek, Audrey, Martin-Misener, Ruth et al. (2014) Engaging parents and schools improves uptake of the human papillomavirus (HPV) vaccine: examining the role of the public health nurse. Vaccine 32(36): 4665-71	- Not a relevant study design *This is a survey that looks at factors affecting vaccine uptrake*
Whitaker JA, Poland CM, Beckman TJ et al. Immunization education for internal medicine residents: A cluster-randomized controlled trial. Vaccine 36(14): 1823-1829	- The study did not report any of the outcomes specified in the protocol
White, C M and Lines, D R (1995) Compliance with neonatal hepatitis B vaccination. The Medical journal of Australia 162(11): 613	- Not a peer-reviewed publication
Whittaker, Karen (2002) Lay workers for improving the uptake of childhood immunization. British journal of community nursing 7(9): 474-9	- Systematic review used as source of primary studies

Study	Reason for exclusion
Wigham, Sarah, Ternent, Laura, Bryant, Andrew et al. (2014) Parental financial incentives for increasing preschool vaccination uptake: systematic review. Pediatrics 134(4): e1117-28	- Systematic review used as source of primary studies
Williams, Nia, Woodward, Helen, Majeed, Azeem et al. (2011) Primary care strategies to improve childhood immunisation uptake in developed countries: systematic review. JRSM short reports 2(10): 81	- Systematic review used as source of primary studies
Willis, Natalie, Hill, Sophie, Kaufman, Jessica et al. (2013) "Communicate to vaccinate": the development of a taxonomy of communication interventions to improve routine childhood vaccination. BMC international health and human rights 13: 23	- Does not contain an outcome of relevance to this review *Study aims to develop a taxonomy of communication interventions but does not look at whether the identified studies increase uptake*
Wilson, Matthew W; Brown, Blair J; Miles, Matthew C (2016) A Multicomponent Intervention to Improve Pneumococcal Vaccination Knowledge Among Internal Medicine Residents. MedEdPORTAL : the journal of teaching and learning resources 12: 10414	- Does not contain an outcome of relevance to this review
Wilson, Thad R, Fishbein, Daniel B, Ellis, Peggy A et al. (2005) The impact of a school entry law on adolescent immunization rates. The Journal of adolescent health : official publication of the Society for Adolescent Medicine 37(6): 511-6	- Not a relevant study design *Survey that looks at factors affecting uptake*
Witt, CE, Ulm, M, Redfern, T et al. (2020) Video-assisted counseling for human papillomavirus vaccination: a quality improvement study. Journal of investigative medicine 68(2): 683	- Conference abstract
Wong VWY, Fong DYT, Lok KYW et al. Brief education to promote maternal influenza vaccine uptake: A randomized controlled trial. Vaccine 34(44): 5243-5250	- Study took place in a non-OECD country
Wood, Heidi M; McDonough, Randal P; Doucette, William R (2009) Retrospective financial analysis of a herpes zoster vaccination program from an independent community pharmacy perspective. Journal of the American Pharmacists Association : JAPhA 49(1): 12-7	- Does not contain an outcome of relevance to this review *This study does not have a comparator*

Study	Reason for exclusion
Wright A, Poon EG, Wald J et al. (2012) Randomized controlled trial of health maintenance reminders provided directly to patients through an electronic PHR. Journal of general internal medicine 27(1): 85-92	- Study participants are the wrong age group *This study looked at pneumococcal vaccine but ~50% of participants were under the age of 50 years and only ~15% were over ~63 years old.*
Wright, P.J., Fortinsky, R.H., Covinsky, K.E. et al. (2000) Delivery of preventive services to older black patients using neighborhood health centers. Journal of the American Geriatrics Society 48(2): 124-130	- Does not contain an outcome of relevance to this review *This study does not have a comparator*
Yanagihara, Dolores M, Taira, Deborah A, Davis, James et al. (2005) A health plan intervention to improve pneumococcal vaccination in the elderly. Managed care interface 18(9): 25-30	- The study did not report any of the outcomes specified in the protocol *This study does not focus on the effect of specific interventions.*
Yang TU, Kim E, Park YJ et al. (2016) Successful introduction of an underutilized elderly pneumococcal vaccine in a national immunization program by integrating the pre-existing public health infrastructure. Vaccine 34(13): 1623-1629	- The intervention is a free vaccine- not in scope
Yee, Lynn M, Martinez, Noelle G, Nguyen, Antoinette T et al. (2017) Using a Patient Navigator to Improve Postpartum Care in an Urban Women's Health Clinic. Obstetrics and gynecology 129(5): 925-933	- Vaccine on UK routine schedule but wrong context for administration *Study includes data for HPV vaccination for new mothers. Our age range of interest for HPV vaccine is 11-18 years of age.*
Yeh, Sylvia, Mink, ChrisAnna, Kim, Matthew et al. (2014) Effectiveness of hospital-based postpartum procedures on pertussis vaccination among postpartum women. American journal of obstetrics and gynecology 210(3): 237e1-6	- Vaccine on UK routine schedule but wrong context for administration *Pertussis vaccination given to women post-partum in*

Study	Reason for exclusion
	USA, during pregnancy in UK.
Yokley, J M and Glenwick, D S (1984) Increasing the immunization of preschool children; an evaluation of applied community interventions. Journal of applied behavior analysis 17(3): 313-25	- Study published before 1990 date limit set in review protocol
Yoo GJ, Fang T, Zola J et al. (2012) Destigmatizing hepatitis B in the Asian American community: lessons learned from the San Francisco Hep B Free Campaign. Journal of cancer education : the official journal of the American Association for Cancer Education 27(1): 138-144	- The study did not report any of the outcomes specified in the protocol
Yoost, Jennie Lee, Starcher, Rachael Whitley, King-Mallory, Rebecca Ann et al. (2017) The Use of Telehealth to Teach Reproductive Health to Female Rural High School Students. Journal of pediatric and adolescent gynecology 30(2): 193-198	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Young, S A, Halpin, T J, Johnson, D A et al. (1980) Effectiveness of a mailed reminder on the immunization levels of infants at high risk of failure to complete immunizations. American journal of public health 70(4): 422-4	- Study published before 1990 date limit set in review protocol
Yudin MH; Salaripour M; Sgro MD (2010) Acceptability and feasibility of seasonal influenza vaccine administration in an antenatal clinic setting. Journal of obstetrics and gynaecology Canada : JOGC = Journal d'obstetrique et gynecologie du Canada : JOGC 32(8): 745-748	- Not a relevant study design
Yun, Katherine, Urban, Kailey, Mamo, Blain et al. (2016) Increasing Hepatitis B Vaccine Prevalence Among Refugee Children Arriving in the United States, 2006-2012. American journal of public health 106(8): 1460-2	- Study does not contain an intervention aimed at increasing vaccine uptake
Zajicek-Farber, Michaela L (2010) Building Practice Evidence for Parent Mentoring Home Visiting in Early Childhood. Research on Social Work Practice 20(1): 46-64	- The study did not report any of the outcomes specified in the protocol *This study involves general education for parents. However, they do not mention any compotent that should increase vaccine uptake.*

Study	Reason for exclusion
Zimet, G, Dixon, B, Xiao, S et al. (2016) Can automated physician reminders increase 2nd and 3rd dose administration of HPV vaccine?. Sexually transmitted diseases 43(10): S158	- Conference abstract
Zucker, Rachel A, Reiter, Paul L, Mayer, Melissa K et al. (2015) Effects of a Presidential Candidate's Comments on HPV Vaccine. Journal of health communication 20(7): 783-9	- Study does not contain an intervention aimed at increasing vaccine uptake

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2 **Excluded from the re-runs search**

Study	Reason for exclusion
(2019) Impact of shingrix (recombinant zoster vaccine) second dose reminder member calls by a commercial health plan. Journal of managed care and specialty pharmacy 25: S95-S96	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Abdullahi, Leila H, Kagina, Benjamin M, Ndze, Valantine Ngum et al. (2020) Improving vaccination uptake among adolescents. The Cochrane database of systematic reviews 1: cd011895	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Acampora, Anna, Grossi, Adriano, Barbara, Andrea et al. (2020) Increasing HPV Vaccination Uptake among Adolescents: A Systematic Review. International journal of environmental research and public health 17(21)	- Multicomponent non-RCT. Excluded because there was sufficient RCT evidence for this review
Akojie, Halimat (2021) Strategies for teaching new mothers the importance of vaccination. Dissertation Abstracts International: Section B: The Sciences and Engineering 82(3b): no-specified	- Not a peer-reviewed publication *This is a thesis and was not published in a peer-reviewed journal*
Arendt, F. and Scherr, S. (2020) News-stimulated public-attention dynamics and vaccination coverage during a measles outbreak: An observational study. Social Science and Medicine 265: 113495	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Austin, S., Wooten, K., Dunkle, W. et al. (2021) Increasing HPV Vaccination Support Through a Pilot Film-Based	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Community Engagement. Journal of community health 46(2): 343-348	
Balzarini, F., Frascella, B., Oradini-Alacreu, A. et al. (2020) Does the use of personal electronic health records increase vaccine uptake? A systematic review. Vaccine 38(38): 5966-5978	- Duplicate reference
Barchitta, M., Maugeri, A., Lio, R.M.S. et al. (2021) Vaccination status of mothers and children from the 'mamma & bambino' cohort. Vaccines 9(2): 1-11	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Blanchi, S., Vaux, J., Toque, J.M. et al. (2020) Impact of a catch-up strategy of DT-IPV vaccination during hospitalization on vaccination coverage among people over 65 years of age in france: The HOSPIVAC study (Vaccination during hospitalization). Vaccines 8(2): 1-13	- The vaccine(s) were not on the UK routine vaccine schedule for this age group *Diphtheria, tetanus and polio vaccine are not on the UK vaccination schedule for people aged 65+ years.*
Bond, Amelia M, Volpp, Kevin G, Emanuel, Ezekiel J et al. (2019) Real-time Feedback in Pay-for-Performance: Does More Information Lead to Improvement?. Journal of general internal medicine 34(9): 1737-1743	- Infrastructure before-and-after study. Excluded because there was sufficient RCT and cohort evidence for this review
Bouchez, M., Ward, J.K., Bocquier, A. et al. (2021) Physicians' decision processes about the HPV vaccine: A qualitative study. Vaccine 39(3): 521-528	- Qualitative study
Chantler, Tracey, Pringle, Ellen, Bell, Sadie et al. (2020) Does electronic consent improve the logistics and uptake of HPV vaccination in adolescent girls? A mixed-methods theory informed evaluation of a pilot intervention. BMJ open 10(11): e038963	- Study already identified in the intital search and sift *Already included as a mixed methods study in the qualitative review*
Cunningham, Andrew K, Rourke, Meaghan M, Moeller, James L et al. (2021) HPV Immunization in High School Student-Athletes Receiving Preparticipation Physical Evaluations at Mass Event Versus Other Venues. Sports health 13(1): 91-94	- Not a relevant study design *All participants had access to the same interventions. This study looks at 'risk factors' for getting vaccinated.*

Study	Reason for exclusion
de Cock, Caroline, van Velthoven, Michelle, Milne-Ives, Madison et al. (2020) Use of Apps to Promote Childhood Vaccination: Systematic Review. JMIR mHealth and uHealth 8(5): e17371	- Systematic review that did not include any additional relevant papers
Dempsey, Amanda F, Pyrzanowski, Jennifer, Campbell, Jonathan et al. (2020) Cost and reimbursement of providing routine vaccines in outpatient obstetrician/gynecologist settings. American journal of obstetrics and gynecology 223(4): 562e1-562e8	- Duplicate reference *This is an economic analysis of O'Leary 2019: "Effectiveness of a multimodal intervention to increase vaccination in obstetrics/gynecology settings"*
Duong, H.T. and Hopfer, S. (2021) Let's Chat: Development of a Family Group Chat Cancer Prevention Intervention for Vietnamese Families. Health education & behavior : the official publication of the Society for Public Health Education 48(2): 208-219	- Qualitative study
Duong, H.T. and Hopfer, S. (2020) "Let's Chat": process evaluation of an intergenerational group chat intervention to increase cancer prevention screening among Vietnamese American families. Translational behavioral medicine	- Qualitative study
Eisenhauer, L.; Hansen, B.R.; Pandian, V. (2021) Strategies to improve human papillomavirus vaccination rates among adolescents in family practice settings in the United States: A systematic review. Journal of clinical nursing 30(34): 341-356	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Elliott, T.E., O'Connor, P.J., Asche, S.E. et al. (2021) Design and rationale of an intervention to improve cancer prevention using clinical decision support and shared decision making: A clinic-randomized trial. Contemporary Clinical Trials 102: 106271	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Falkenberg-Olson, A.C., Hayter, K.L., Holzer, R.A. et al. (2020) Infant Vaccinations among Mothers with Substance-Use Disorders: A Comparative Study. Clinical medicine & research	- Multicomponent non-RCT. Excluded because there was sufficient RCT evidence for this review
Flood, T., Wilson, I.M., Prue, G. et al. (2020) Impact of school-based educational interventions in middle adolescent populations (15-17yrs) on human papillomavirus (HPV) vaccination uptake and perceptions/knowledge of HPV and its associated cancers: A systematic review. Preventive Medicine 139: 106168	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Foss, Hakan Safaralilo, Oldervoll, Ann, Fretheim, Atle et al. (2019) Communication around HPV vaccination for adolescents in low- and middle-income countries: a systematic scoping overview of systematic reviews. Systematic reviews 8(1): 190	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Glanz, J.M., Wagner, N.M., Narwaney, K.J. et al. (2020) Web-Based Tailored Messaging to Increase Vaccination: A Randomized Clinical Trial. Pediatrics 146(5): e20200669	- Study already identified in the intital search and sift
Gleeson, S; Kelleher, K; Gardner, W (2016) Evaluating a Pay-for-Performance Program for Medicaid Children in an Accountable Care Organization. JAMA pediatrics 170(3): 259-266	- Infrastructure before-and-after study. Excluded because there was sufficient RCT and cohort evidence for this review
Gori, D., Costantino, C., Odone, A. et al. (2020) The impact of mandatory vaccination law in Italy on mmr coverage rates in two of the largest italian regions (Emilia-romagna and sicily): An effective strategy to contrast vaccine hesitancy. Vaccines 8(1): 57	- Infrastructure before-and-after study. Excluded because there was sufficient RCT and cohort evidence for this review
Hansen, Peter R; Schmidtblaicher, Matthias; Brewer, Noel T (2020) Resilience of HPV vaccine uptake in Denmark: Decline and recovery. Vaccine 38(7): 1842-1848	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Hohmann, Lindsey A, Hastings, Tessa J, Ha, David R et al. (2019) Impact of a multi-component immunization intervention on pneumococcal and herpes zoster vaccinations: A randomized controlled trial of community pharmacies in 2 states. Research in social & administrative pharmacy : RSAP 15(12): 1453-1463	- The study did not report any of the outcomes specified in the protocol *And unable to determine what proportion of individuals were over 65 years of age*
Ilozumba, O., Schmidt, P., Ket, J.C.F. et al. (2021) Can mHealth interventions contribute to increased HPV vaccination uptake? A systematic review. Preventive Medicine Reports 21: 101289	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
JPRN-UMIN000039273 (2020) A blinded RCT to verify the effect of changing the awareness and behavior of HPV vaccination by video viewing intervention for parents who have daughters of targeted generation. http://www.who.int/trialsearch/Trial2.aspx?TrialID=JPRN-UMIN000039273	- This is a study protocol without a published study

Study	Reason for exclusion
Kaufman, J., Attwell, K., Hauck, Y. et al. (2020) Designing a multi-component intervention (P3-MumBubVax) to promote vaccination in antenatal care in Australia. Health promotion journal of Australia : official journal of Australian Association of Health Promotion Professionals	- The study did not report any of the outcomes specified in the protocol *This study is about how an intervention was developed. There is no qualitative data published in this study.*
Kuehne, F., Sanftenberg, L., Dreischulte, T. et al. (2020) Shared decision making enhances pneumococcal vaccination rates in adult patients in outpatient care. International Journal of Environmental Research and Public Health 17(23): 1-15	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Lin, S.-C., Tam, K.-W., Yen, J.Y.-C. et al. (2020) The impact of shared decision making with patient decision aids on the rotavirus vaccination rate in children: A randomized controlled trial. Preventive Medicine 141: 106244	- Study not carried out in an OECD country *Study took place in Taiwan.*
Loskutova, Natalia Y, Smail, Craig, Callen, Elisabeth et al. (2020) Effects of multicomponent primary care-based intervention on immunization rates and missed opportunities to vaccinate adults. BMC family practice 21(1): 46	- Multicomponent non-RCT. Excluded because there was sufficient RCT evidence for this review
Lott, B.E., Okusanya, B.O., Anderson, E.J. et al. (2020) Interventions to increase uptake of Human Papillomavirus (HPV) vaccination in minority populations: A systematic review. Preventive Medicine Reports 19: 101163	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Maggio, L.A.; Krakow, M.; Moorhead, L.L. (2020) There were some clues': A qualitative study of heuristics used by parents of adolescents to make credibility judgements of online health news articles citing research. BMJ Open 10(8): e039692	- Qualitative study
Maria, DS (2020) 8. Efficacy of a Student-Nurse Brief Parent-Based Sexual Health Intervention to Increase HPV Vaccination Among Adolescents. Journal of adolescent health 66(2): S4-S5	- Conference abstract
McAdam-Marx, C., Tak, C., Petigara, T. et al. (2019) Impact of a guideline-based best practice alert on pneumococcal vaccination rates in adults in a primary care setting. BMC health services research 19(1): 474	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review

Study	Reason for exclusion
Nagykaldi, Z., Scheid, D., Zhao, Y.D. et al. (2020) A sustainable model for preventive services in rural counties: The healthier together study. Journal of the American Board of Family Medicine 33(5): 698-706	- Multicomponent non-RCT. Excluded because there was sufficient RCT evidence for this review
NCT04638010 (2020) Increasing Breast, Cervical, and Colorectal Cancer Screening and HPV Vaccination Among Underserved Texans. https://clinicaltrials.gov/show/NCT04638010	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
O'Leary, Sean T, Narwaney, Komal J, Wagner, Nicole M et al. (2019) Efficacy of a Web-Based Intervention to Increase Uptake of Maternal Vaccines: An RCT. American journal of preventive medicine 57(4): e125-e133	- Study already identified in the intital search and sift
O'Leary, Sean T, Pyrzanowski, Jennifer, Brewer, Sarah E et al. (2019) Effectiveness of a multimodal intervention to increase vaccination in obstetrics/gynecology settings. Vaccine 37(26): 3409-3418	- Duplicate reference
Orefice, R. and Quinlivan, J.A. (2019) Small interface changes have dramatic impacts: how mandatory fields in electronic medical records increased pertussis vaccination rates in Australian obstetric patients. BMJ health & care informatics 26(1): 0	- This study has already been included in RQ1
Perkins, RB, Legler, A, Jansen, E et al. (2020) Improving HPV Vaccination Rates: a Stepped-Wedge Randomized Trial. Pediatrics 146(1)	- Education and reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Peterson, Caryn E, Silva, Abigail, Holt, Hunter K et al. (2020) Barriers and facilitators to HPV vaccine uptake among US rural populations: a scoping review. Cancer causes & control : CCC 31(9): 801-814	- Qualitative study
Pot, Mirjam, Paulussen, Theo Gwm, Ruiter, Robert Ac et al. (2020) Dose-Response Relationship of a Web-Based Tailored Intervention Promoting Human Papillomavirus Vaccination: Process Evaluation of a Randomized Controlled Trial. Journal of medical Internet research 22(7): e14822	- Duplicate reference *This is a process evaluation of Pot 2017, which has been assessed in the education evidence review.*

Study	Reason for exclusion
Rani, Uzma, Darabaner, Ellen, Seserman, Michael et al. (2020) Public Education Interventions and Uptake of Human Papillomavirus Vaccine: A Systematic Review. Journal of public health management and practice : JPHMP	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Saitoh, A., Katsuta, T., Mine, M. et al. (2020) Effect of a vaccine information statement (VIS) on immunization status and parental knowledge, attitudes, and beliefs regarding infant immunization in Japan. Vaccine 38(50): 8049-8054	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Scarinci, Isabel C; Hansen, Barbara; Kim, Young-Il (2020) HPV vaccine uptake among daughters of Latinx immigrant mothers: Findings from a cluster randomized controlled trial of a community-based, culturally relevant intervention. Vaccine 38(25): 4125-4134	- Study already identified in the intital search and sift *It was already included in the education evidence review*
Schellenberg, Naomi and Crizzle, Alexander M. (2020) Vaccine hesitancy among parents of preschoolers in Canada: a systematic literature review. Canadian journal of public health = Revue canadienne de sante publique 111(4): 562-584	- Systematic review that did not include any additional relevant papers
Spina, C.I., Brewer, S.E., Ellingson, M.K. et al. (2020) Adapting Center for Disease Control and Prevention's immunization quality improvement program to improve maternal vaccination uptake in obstetrics. Vaccine 38(50): 7963-7969	- Infrastructure before-and-after study. Excluded because there was sufficient RCT and cohort evidence for this review
Staras, S.A.S., Richardson, E., Merlo, L.J. et al. (2021) A feasibility trial of parent HPV vaccine reminders and phone-based motivational interviewing. BMC public health 21(1): 109	- The study did not report any of the outcomes specified in the protocol
Staras, SAS, Vadaparampil, ST, Thompson, LA et al. (2020) Postcard reminders for HPV vaccination mainly primed parents for providers' recommendations. Preventive medicine reports 20	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Szilagyi, Peter, Albertin, Christina, Gurfinkel, Dennis et al. (2020) Effect of State Immunization Information System Centralized Reminder and Recall on HPV Vaccination Rates. Pediatrics 145(5)	- Duplicate reference
Thompson, E.L., Livingston, M.D., Daley, E.M. et al. (2020) Rhode Island Human Papillomavirus Vaccine School Entry	- Study already identified in the intital search and sift

Study	Reason for exclusion
Requirement Using Provider-Verified Report. American Journal of Preventive Medicine 59(2): 274-277	*It was included in the accessibility evidence review.*
Tull, Fraser, Borg, Kim, Knott, Cameron et al. (2019) Short Message Service Reminders to Parents for Increasing Adolescent Human Papillomavirus Vaccination Rates in a Secondary School Vaccine Program: A Randomized Control Trial. The Journal of adolescent health : official publication of the Society for Adolescent Medicine 65(1): 116-123	- Study already identified in the intital search and sift *This study had already been included in the reminders evidence review.*
Tyler, R., Kile, S., Strain, O. et al. (2020) Impact of pharmacist intervention on completion of recombinant zoster vaccine series in a community pharmacy. Journal of the American Pharmacists Association	- Reminders non-RCT. Excluded because there was sufficient RCT evidence for this review
Ulm, MA, Redfern, T, Pierce, V WF et al. (2020) Video-assisted counseling for human papillomavirus vaccination: a quality improvement study. Gynecologic oncology 159: 288-289	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Wallace-Brodeur, R., Li, R., Davis, W. et al. (2020) A quality improvement collaborative to increase human papillomavirus vaccination rates in local health department clinics. Preventive Medicine 139: 106235	- Education non-RCT. Excluded because there was sufficient RCT evidence for this review
Wilder-Smith, Annika B and Qureshi, Kaveri (2020) Resurgence of Measles in Europe: A Systematic Review on Parental Attitudes and Beliefs of Measles Vaccine. Journal of epidemiology and global health 10(1): 46-58	- Qualitative study
Wilkinson, Tracey A, Dixon, Brian E, Xiao, Shan et al. (2019) Physician clinical decision support system prompts and administration of subsequent doses of HPV vaccine: A randomized clinical trial. Vaccine 37(31): 4414-4418	- Study already identified in the intital search and sift *This study has already been included in the reminders evidence review.*
Yunusa, Umar, Garba, Saleh Ngaski, Umar, Addakano Bello et al. (2021) Mobile phone reminders for enhancing uptake, completeness and timeliness of routine childhood immunization in low and middle income countries: A systematic review and meta-analysis. Vaccine 39(2): 209-221	- Systematic review that did not include any additional relevant papers

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1 Economic studies

Study	Reason for exclusion
Ameel, B.M.; Beigi, R.H.; Caughey, A.B. (2018) Cost-effectiveness of the Tdap vaccine during pregnancy. American Journal of Obstetrics and Gynecology 218(1supplement1): 516-s517	- Study did not consider increasing uptake
Atkins, Katherine E, Fitzpatrick, Meagan C, Galvani, Alison P et al. (2016) Cost-Effectiveness of Pertussis Vaccination During Pregnancy in the United States. American journal of epidemiology 183(12): 1159-70	- Study did not consider increasing uptake
Bae, Geun-Ryang, Choe, Young June, Go, Un Yeong et al. (2013) Economic analysis of measles elimination program in the Republic of Korea, 2001: a cost benefit analysis study. Vaccine 31(24): 2661-6	- Study did not consider increasing uptake
Bettampadi, D., Boulton, M.L., Power, L.E. et al. (2019) Are community health workers cost-effective for childhood vaccination in India?. Vaccine 37(22): 2942-2951	- Non-OECD country
Beutels, Ph and Gay, N J (2003) Economic evaluation of options for measles vaccination strategy in a hypothetical Western European country. Epidemiology and infection 130(2): 273-83	- Study did not consider increasing uptake
Burmeister, J., Schroeder, M., Veach, S. et al. (2013) The cost effectiveness of various marketing techniques on Tdap vaccination rates within two community pharmacies. Journal of the American Pharmacists Association 53(2): e45	- No results reported - Did not include QALYs as an outcome - adult studies
Chesson, Harrell W and Markowitz, Lauri E (2015) The cost-effectiveness of human papillomavirus vaccine catch-up programs for women. The Journal of infectious diseases 211(2): 172-4	- No results reported
Chiappini, Elena, Stival, Alessia, Galli, Luisa et al. (2013) Pertussis re-emergence in the post-vaccination era. BMC infectious diseases 13: 151	- Study did not consider increasing uptake
Derrah, K., Ameel, B.M., Hersh, A.R. et al. (2020) 1053: Cost-effectiveness of Tdap vaccination during pregnancy. American Journal of Obstetrics and Gynecology 222(1supplement): 652	- Study did not consider increasing uptake
Ding, Y., Hay, J., Yeh, S.H. et al. (2012) Cost-benefit analysis of hospital based postpartum vaccination with combined tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (TDAP). Value in Health 15(4): a241	- Study did not consider increasing uptake
Ding, Yao, Yeh, Sylvia H, Mink, Chris Anna M et al. (2013) Cost-benefit analysis of hospital based postpartum vaccination with combined tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap). Vaccine 31(22): 2558-64	- Study did not consider increasing uptake

Study	Reason for exclusion
Fernandes, E.G., Rodrigues, C.C.M., Sartori, A.M.C. et al. (2019) Economic evaluation of adolescents and adults' pertussis vaccination: A systematic review of current strategies. Human Vaccines and Immunotherapeutics 15(1): 14-27	- Study did not consider increasing uptake
Fernandes, Eder Gatti, Sartori, Ana Marli Christovam, de Soarez, Patricia Coelho et al. (2020) Cost-effectiveness analysis of universal adult immunization with tetanus-diphtheria-acellular pertussis vaccine (Tdap) versus current practice in Brazil. Vaccine 38(1): 46-53	- Non-OECD country
Fernandez-Cano, Maria Isabel; Armadans Gil, Lluis; Campins Marti, Magda (2015) Cost-benefit of the introduction of new strategies for vaccination against pertussis in Spain: cocooning and pregnant vaccination strategies. Vaccine 33(19): 2213-2220	- Study did not consider increasing uptake
Getsios D, Caro J J, Caro G, De Wals P, Law B J, Robert Y, Lance J M R (2002) Instituting a routine varicella vaccination program in Canada: an economic evaluation. Pediatric Infectious Disease Journal 21(6): 542-547	- Vaccine not routine in the UK
Greengold, Barbara, Nyamathi, Adeline, Kominski, Gerald et al. (2009) Cost-effectiveness analysis of behavioral interventions to improve vaccination compliance in homeless adults. Vaccine 27(5): 718-25	- Vaccine not routine in the UK
Hayman, D T S, Marshall, J C, French, N P et al. (2017) Cost-benefit analyses of supplementary measles immunisation in the highly immunized population of New Zealand. Vaccine 35(37): 4913-4922	- Study did not consider increasing uptake
Hoshi, Shu-Ling, Seposo, Xerxes, Okubo, Ichiro et al. (2018) Cost-effectiveness analysis of pertussis vaccination during pregnancy in Japan. Vaccine 36(34): 5133-5140	- Study did not consider increasing uptake
Hui, Charles, Dunn, Jessica, Morton, Rachael et al. (2018) Interventions to Improve Vaccination Uptake and Cost Effectiveness of Vaccination Strategies in Newly Arrived Migrants in the EU/EEA: A Systematic Review. International journal of environmental research and public health 15(10)	- Systematic review - the only CE study did not consider increasing uptake - Not a cost-effectiveness study
Hurley, L.P., Beaty, B., Lockhart, S. et al. (2017) Centralized vaccine reminder/recall to improve adult vaccination rates at an urban safety net health system. Journal of General Internal Medicine 32(2supplement1): 135-s136	- Did not include QALYs as an outcome - adult studies
Kempe, Allison, Barrow, Jennifer, Stokley, Shannon et al. (2012) Effectiveness and cost of immunization recall at school-based health centers. Pediatrics 129(6): e1446-52	- Not a cost-effectiveness study
Lugner, Anna K, van der Maas, Nicoline, van Boven, Michiel et al. (2013) Cost-effectiveness of targeted vaccination to protect new-borns against pertussis: comparing neonatal, maternal,	- Study did not consider increasing uptake

Study	Reason for exclusion
and cocooning vaccination strategies. Vaccine 31(46): 5392-7	
Major, J.; Wingate, L.T.; Oishi, T.S. (2016) A cost-effectiveness evaluation of a multifaceted community pharmacy intervention to increae rates of herpes zoster vaccination. Value in Health 19(3): a217	- Vaccine not routine in the UK
Ouwens, M., Littlewood, K., Sauboin, C. et al. (2010) Impact of mmrv mass vaccination with or without a catch up program on the incidence of varicella complications in France. Value in Health 13(7): a430	- Vaccine not routine in the UK
Poirrier, J.E., Mungall, B., Lee, I.H. et al. (2014) Cost-effectiveness of maternal immunisation for pertussis in new zealand. Value in Health 17(7): a806	- Study did not consider increasing uptake
Portnoy, A., Campos, N.G., Sy, S. et al. (2020) Impact and cost-effectiveness of human papillomavirus vaccination campaigns. Cancer Epidemiology Biomarkers and Prevention 29: 22-30	- Study did not consider increasing uptake - Non-OECD country
Rivero-Santana, Amado, Cuellar-Pompa, Leticia, Sanchez-Gomez, Luis M et al. (2014) Effectiveness and cost-effectiveness of different immunization strategies against whooping cough to reduce child morbidity and mortality. Health policy (Amsterdam, Netherlands) 115(1): 82-91	- Study did not consider increasing uptake
Russell, Louise B, Pentakota, Sri Ram, Toscano, Cristiana Maria et al. (2016) What Pertussis Mortality Rates Make Maternal Acellular Pertussis Immunization Cost-Effective in Low- and Middle-Income Countries? A Decision Analysis. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 63(suppl4): 227-s235	- Non-OECD country - Study did not consider increasing uptake
Suh, Christina A, Saville, Alison, Daley, Matthew F et al. (2012) Effectiveness and net cost of reminder/recall for adolescent immunizations. Pediatrics 129(6): e1437-45	- Cost perspective was inappropriate (private practice, net additional revenue)
Terranella, A., Beeler Asay, G.R., Messonnier, M.L. et al. (2013) Pregnancy dose Tdap and postpartum cocooning to prevent infant pertussis: A decision analysis. Obstetrical and Gynecological Survey 68(9): 615-616	- Study did not consider increasing uptake
Terranella, Andrew, Asay, Garrett R Beeler, Messonnier, Mark L et al. (2013) Pregnancy dose Tdap and postpartum cocooning to prevent infant pertussis: a decision analysis. Pediatrics 131(6): e1748-56	- Study did not consider increasing uptake
Van Bellinghen, Laure-Anne, Dimitroff, Alex, Haberl, Michael et al. (2018) Is adding maternal vaccination to prevent whooping cough cost-effective in Australia?. Human vaccines & immunotherapeutics 14(9): 2263-2273	- Study did not consider increasing uptake
van Hoek, Albert Jan, Campbell, Helen, Amirthalingam, Gayatri et al. (2016) Cost-effectiveness and programmatic benefits of	- Study did not consider increasing uptake

Study	Reason for exclusion
maternal vaccination against pertussis in England. The Journal of infection 73(1): 28-37	
Wateska, A.R., Nowalk, M.P., Lin, C.J. et al. (2019) An intervention to improve pneumococcal vaccination uptake in high risk 50-64 year olds vs. expanded age-based recommendations: an exploratory cost-effectiveness analysis. Human Vaccines and Immunotherapeutics 15(4): 863-872	- Vaccine not routine in this age group in the UK
Westra, T.A., De Vries, R., Tamminga, H.J. et al. (2009) Cost-effectiveness of a cocooning immunization strategy against pertussis for The Netherlands. Value in Health 12(7): a425-a426	- Study did not consider increasing uptake
Westra, Tjalke A, de Vries, Robin, Tamminga, Johannes J et al. (2010) Cost-effectiveness analysis of various pertussis vaccination strategies primarily aimed at protecting infants in the Netherlands. Clinical therapeutics 32(8): 1479-95	- Study did not consider increasing uptake

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2

Appendix K – Research recommendations

K.1 Research recommendation 1

What levels and types of provider incentives are effective and acceptable to increase immunisation rates in the UK?

K.2 Why this is important

There is some evidence that incentives for providers can increase vaccine uptake. However, current evidence base is limited, low quality and not based in the UK. GPs already receive payment for vaccinations to cover the cost of the vaccination and the time taken to identify, invite and administer the vaccinations in the UK. There are additional payments for vaccinations available under the Quality and Outcome Framework (QoF) if certain conditions are met, such as vaccinating 90-95% of children who reached 18 months old in the preceding 12 months with at least one dose of MMR (Annex A: new QOF indicators for 2021/22). However, the committee noted that in some areas it may be much harder to obtain the level of vaccination needed to trigger a reward because they may contain larger numbers of people who are difficult to reach, for example in more deprived areas with larger immigrant communities who do not speak English. This may be discouraging for the provider as they may need to expend a lot more effort to obtain a lower vaccination rate than providers in other areas with higher baseline rates of uptake. In addition, the incentives available to providers are subject to change and it is unclear what types and levels of incentives are most effective in the UK.

With the limited evidence in this area, the committee decided it was important for more research to be carried out to evaluate whether provider incentives can increase vaccine uptake and what levels of incentive are required. The committee were interested in both the effectiveness of different types of provider incentives and the acceptability of these types of interventions when used in the UK healthcare system.

Importance to 'patients' or the population	It is unclear what levels and types of incentives aimed at providers are effective at increasing uptake of routine vacations and whether they are acceptable. Suitably incentivising providers could lead to an increase in vaccine uptake and a reduction in vaccine preventable diseases in the community.
Relevance to NICE guidance	Medium: the research is relevant to the recommendations in the guidance, but the research recommendations are not essential to future updates Additional evidence about the effectiveness of incentives to increase uptake could help improve the existing recommendations or lead to new recommendations aimed at providers.
Relevance to the NHS	Increasing vaccination uptake reduce the incidence of vaccine preventable diseases. This would lead to reduced numbers of hospitalisations and other medical interventions to treat the diseases thereby freeing up resources that could be deployed to address other priorities.
National priorities	There is a new DHSC vaccination strategy due in late 2021 and it is expected that this work would fall under the goal of increasing the uptake of routine vaccinations.
Current evidence base	Three, moderate to very low quality, quantitative studies investigated the use of provider incentives in the USA for children aged 0-5 years and young people aged 11-18 years.

	Most studies demonstrated an increase in vaccine uptake with provider incentives. Qualitative evidence reported mixed views from parents and carers on the acceptability of provider incentives.
Equality considerations	To ensure equality, incentives would have to be appropriate for different communities

1

K.123 Modified PICO table

3

Population	Immunisation providers
Intervention	Different types and levels of incentives to increase uptake of routine UK vaccinations. Incentives including: • community target setting • changes in targets or payment systems
Comparator	Type of incentive compared to: • usual processes • other incentives or Different levels of the same type of incentive compared to each other
Outcome	Quantitative outcomes including: • uptake of routine vaccinations • offers of routine vaccinations. Qualitative outcomes including: • acceptability of the incentives • views about implementation • other views about the intervention or general barriers facilitators to uptake that relate to incentives.
Study design	• Quantitative study: RCT or cluster RCT, cohort studies • Qualitative study: interviews, focus groups only (not surveys or open -ended questions on surveys)
Timeframe	There is no specified time frame in which the study needs to be completed.
Additional information	• Vaccinations to be incentivised must be on the UK routine schedule (apart from influenza, see below) and the incentive must be aimed at increasing uptake in the relevant population for this schedule. • Influenza vaccination is not of interest because it is out of scope of the NICE guideline on routine vaccination.

4

K.1.14 Research recommendation 2

What is the effectiveness and acceptability of incentives to increase uptake of routine vaccines?

K.1.15 Why this is important

There is some evidence that providing incentives to people who have vaccines can increase vaccine uptake. However, current evidence is limited, low quality and not based in the UK. As a result, the committee decided it was important for future research to examine whether incentives aimed at eligible individuals, their parents, family members or carers (as appropriate) are an effective and acceptable way of increasing routine vaccinations in the UK. There is currently no evidence about what the most effective form of incentive could be, whether this is financial or non-financial and so it is important for research to consider different types of incentives.

Importance to 'patients' or the population	It is unclear whether financial and non-financial incentives are effective at increasing the uptake of routine vaccinations in the UK in and whether they are acceptable to the population. Increasing vaccination uptake will provide benefits by reducing vaccine preventable diseases as well as helping to develop herd immunity in the wider population.
Relevance to NICE guidance	Medium: the research is relevant to the recommendations in the guidance, but the research recommendations are not essential to future updates. Additional evidence about the effectiveness of incentives to increase uptake could help improve the existing recommendations or lead to new recommendations.
Relevance to the NHS	A reduced incidence of vaccine preventable diseases would be expected if vaccination rates increase and would lead to reduced numbers of hospitalisations and other medical interventions to treat the diseases thereby freeing up resources that could be deployed to address other priorities.
National priorities	There is a new DHSC vaccination strategy due in late 2021 and it is expected that this work would fall under the goal of increasing the uptake of routine vaccinations.
Current evidence base	One, low quality, quantitative study was identified that investigated the use of financial incentives in the USA for HPV vaccination. No UK evidence was identified.
Equality considerations	Financial incentives might have more of an impact for people with lower income. The most appropriate incentives for different communities would need to be considered.

K.1.16 Modified PICO table

Population	• Individuals eligible for routine schedule vaccination(s) or their parents or carers (as appropriate) • Healthcare staff organising the vaccination programmes or administering vaccinations (for the qualitative research only)

Intervention	Incentive schemes to increase uptake of routine UK vaccination (excluding influenza vaccination). Incentives can be: • financial (e.g. raffles, payment for accepting vaccinations) • non-financial • aimed at increasing vaccination directly or indirectly (see also additional information below)
Comparator	Usual processes
Outcome	Quantitative outcomes including: • uptake of vaccinations on the routine schedule • offers of vaccination • responses to invitations or consent form return (if this behaviour is being incentivised) Qualitative outcomes including: • acceptability of the incentives • views about implementation • other views about the intervention or general barriers facilitators to uptake that relate to incentives. • The qualitative work should look at the views of eligible individuals, their parents, family members or careers (as appropriate) and relevant healthcare staff.
Study design	• Quantitative study: RCT or cluster RCT, cohort studies • Qualitative study: Interviews, focus groups only (not surveys or open - ended questions on surveys)
Timeframe	There is no specified time frame in which the study needs to be completed.
Additional information	• Vaccinations to be incentivised must be on the UK routine schedule. The incentive must be aimed at increasing uptake in the relevant population for this schedule. • The incentives would be aimed at parents/carers of young children but could be aimed at young people or their parents/carers for vaccinations of adolescents. Incentives for adult vaccinations would be aimed at the individual eligible for vaccination or their carers (with appropriate consent). • Incentives do not necessarily need to be directly related to receipt of a vaccine. Could also be for other behaviours (for example, consent form return) that ultimately result in increased vaccine uptake.

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K.1.7 Research recommendation 3

What is the effectiveness and acceptability of quasi-mandation to increase vaccine uptake of routine vaccines?

K.1.8 Why this is important

Vaccine mandates are used in some countries, for example in some states in USA, and may require a child to be vaccinated before they can attend school. Educational mandates, which require education to be accepted before a child can attend school, are not currently used in the UK but could be a more acceptable method to increase vaccine uptake than school entry mandates. However, limited evidence was identified for both types of mandation and none of the studies were UK based. In contrast, Adams 2015 included detailed qualitative findings about the acceptability of mandatory vaccinations in general in the UK. In this work, parents had mixed views about mandation, but some found this to be a more acceptable method of increasing uptake than the use of financial incentives aimed at parents. The committee agreed that the existing quantitative evidence about the effectiveness of mandation was inconclusive and agreed that further research would be useful.

K.1.9 Rationale for research recommendation

Importance to communities	It is unclear whether entry or education vaccine mandation is effective at increasing the uptake of routine vaccinations. If they could increase vaccine uptake this would reducing vaccine preventable diseases for individual as well as helping to develop herd immunity in the wider population.
Relevance to NICE guidance	Medium: the research is relevant to the recommendations in the guidance, but the research recommendations are not essential to future updates. Additional evidence about the effectiveness of incentives to increase uptake could help improve the existing recommendations or lead to new recommendations.
Relevance to the NHS	A reduced incidence of vaccine preventable diseases would be expected if vaccination rates increase and would lead to reduced numbers of hospitalisations and other medical interventions to treat the diseases thereby freeing up resources that could be deployed to address other priorities.
National priorities	There is a new DHSC vaccination strategy due in late 2021 and it is expected that this work would fall under the goal of increasing the uptake of routine vaccinations.
Current evidence base	One, low-quality, quantitative study investigated the use of education or school entry mandates for the HPV vaccine in the USA. This study did not demonstrate an increase in vaccine uptake with education mandates and the school-entry mandate results favoured control (although the upper 95% CI touched the line of no effect). Qualitative evidence reported mixed views from parents and carers on the acceptability of mandates.
Equality considerations	The effect on people in lower socioeconomic groups should be considered.

K.1.10 Modified PICO table

2

Population	• Individuals eligible for routine schedule vaccinations or their family members or carers (as appropriate) • Healthcare staff organising the vaccination programmes or administering vaccinations (for the qualitative research only)
Intervention	Quasi-mandation schemes including: • Entry mandates (nursery, primary school, high school) • Education mandates (nursery, primary school, high school) • Other mandates The mandates would apply to the eligible individuals but may be targeted at incentivising their family members or carers (as appropriate) to allow them to be vaccinated.
Comparator	• Usual processes • Other types of mandates
Outcome	Quantitative outcomes including: • uptake of routine vaccinations by eligible people • offers of vaccination Qualitative outcomes including: • acceptability of the incentives • views about implementation • other views about the intervention or general barriers or facilitators to uptake that relate to incentives. The qualitative work should look at the views of eligible people, their family members or careers (as appropriate) and relevant healthcare staff.
Study design	• Quantitative study: cohort studies, controlled before and after studies, interrupted time series • Qualitative study: interviews, focus groups only (not surveys or open -ended questions on surveys)
Timeframe	There is no specified time frame in which the study needs to be completed.
Additional information	• Vaccinations to be mandated must be on the UK routine schedule (apart from influenza, see below) and the incentive must be aimed at increasing uptake in the relevant population for this schedule. • Influenza vaccination is not of interest because it is out of scope of the NICE guideline on routine vaccination.

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