Swiss TPH
Swiss Tropical and Public Health Institute
Schweizerisches Tropen- und Public Health-Institut
Institut Tropical et de Santé Publique Suisse

Swiss Centre for International Health

OFSP

Support to the Swiss immunisation programme

Literature review

Xavier Bosch-Capblanch, Swiss TPH

Christian Auer, Swiss TPH

1st July 2013

15th August 2013

Swiss Centre for International Health
Swiss Tropical and Public Health Institute
Socinstrasse 57
P.O.Box
4002 Basel
Switzerland
Internet: www.swisstph.ch

Swiss TPH
Swiss Tropical and Public Health Institute
Schweizerisches Tropen- und Public Health-Institut
Institut Tropical et de Santé Publique Suisse

Contact

Dr. Xavier Bosch-Capblanch. SCIH, Swiss Tropical and Public Health Institute

Group Leader. Systems Support Unit

Socinstrasse 57, PO Box 4002 Basel (Switzerland)

Telephone direct line: +41 61 284 83 19; Fax +41 61 284 81 03
E-mail x.bosch@unibas.ch

Website http://www.swisstph.ch/

Disclaimer

The views and ideas expressed herein are those of the author(s) and do not necessarily imply or reflect the opinion of the Institute.

Abbreviations

CBA	Controlled Before and After study
CHE	Switzerland
CI	Confidence Interval
DEU	Germany
FRA	France
HCW	Health Care Worker
HRA	Health Risk Appraisal
ITA	Italy
ITS	Interrupted Time Series study
MMR	Measles, Mumps and Rubella vaccine
NIP	National Immunisation Programme
OFSP	Office fédéral de la santé publique
OR	Odds Ratio
RCT	Randomised Controlled Trial
RR	Relative Risk
SCIH	Swiss Centre for International Health (a department of the Swiss TPH)
SES	Socio-economic status
SR	Systematic Review
Swiss TPH	Swiss Tropical and Public Health Institute
WIC	Women, Infants and Children

Table of contents

List of tables

List of figures

1 Executive summary

Vaccination coverage in Switzerland greatly varies between cantons and may not be high enough to achieve elimination targets, to control diseases or to avoid epidemics. Cognisant of the challenges of reaching high levels of vaccination coverage, the Office fédéral de la santé publique (OFSP) in Switzerland is developing a new National Immunisation Programme through a consultative process which includes (a) the identification of challenges for achieving higher coverage levels and (b) the retrieval of relevant evidence on interventions to improve vaccine coverage. Challenges were described by means of a 'diagnostic tree'. The latter is presented in this literature review: the objective of this review is to identify relevant evidence to improve coverage by synthesising primary research and systematic reviews (SR) on interventions to improve vaccination coverage.

We have carried out a review using standard research synthesis methods adapted to the limited scope of this work (e.g. no double data extraction or quality of evidence assessments were done). A search strategy was run, references were scrutinised for relevance and those relevant for inclusion or exclusion were identified. Data was extracted from included references and summarised in four categories according to the size of the effects.

From 4,584 primary studies and 6,134 SR retrieved with the search strategy, 22 and 18 where finally included, respectively. Nine of the primary studies were from Switzerland, and most of them dealt with influenza vaccination. SR included studies from high and low- and middle-income countries from a whole variety of settings and population ages.

The most frequently reported interventions were those related to information and education targeting users, and partially health workers as well. The least reported were organisational or governance interventions. In all types of interventions, the effects varied greatly between studies and SR, without a clear pattern.

Interpretation of the effects of interventions has to be cautious due to the limitations of the underlying evidence and of this review as well. However, evidence suggests that:

- organisational, education and information interventions may be promising, feasible and relevant to Switzerland, and there exists evidence from SR and primary studies to look at;
- further evidence is needed to support the findings of this review on implementation issues of organisational interventions, since these are very context-specific; this evidence may be available in qualitative studies or reviews and from non-research programmatic evidence from Switzerland;
- information, communication and education intervention showed examples of promising results, although this may be due to the relative abundance of studies and SR on these areas;
- there is relatively lack of evidence on interventions addressing 'supply' or ways to deliver vaccination; the available evidence should be looked under the perspective of the known barriers to vaccination in Switzerland;
- no evidence was retrieved on monitoring and evaluation studies, since these are likely to describe factors associated with vaccination status rather than effects on vaccination coverage.
- combined interventions should be considered to generate new ideas on what could be done in Switzerland which is not already done, and to support the findings on the effect of single interventions.

A synthesis of findings can be found in Table 2, section 5.3, page 8 (primary studies) and in Table 3, section 0, page 11 (systematic reviews); excluded references in Table 5, Annex 3, page A-3 (primary studies) and in Table 6, Annex 3, page A-4 (systematic reviews), included references in Table 7, Annex 4, page A-7 (primary studies) and in Table 8, Annex 4, A-9 (systematic reviews), and the detail of findings in Table 9, Annex 5, page A-11 (primary studies) and in Table 10, Annex 5, page A-11 (systematic reviews).

2 Background

In Switzerland, as in many European and developed countries, vaccination coverage for most of the recommended antigens is relatively high. However, vaccination coverage greatly varies between cantons and may not be high enough to achieve elimination targets, to control disease or to avoid epidemics in the whole country.

Cognisant of these issues, the Office fédéral de la santé publique (OFSP) commissioned a study with two objectives: (1) to identify the problems of vaccination uptake in Switzerland; and (2) to describe the available evidence in interventions to address those problems, with a special focus on Switzerland and on countries in the same geographical and socio-economic zone.

The identification of problems of vaccination uptake has already been completed and submitted to the OFPS. In this report we present the findings of the literature review of interventions to improve vaccination coverage.

3 Objective of the literature review

The objective of the literature review is to address the research question: what interventions are potentially relevant and effective in improving routine vaccination coverage of people living in Switzerland?

4 Methods

4.1 Criteria for considering studies

Types of studies

- Randomised or quasi-randomised controlled trials (RCT), controlled before and after studies (CBA), interrupted time series (ITS).
- Published in any language in Switzerland and neighbouring countries in the last 10 years.
- Systematic reviews (SR): where systematics reviews addressing the same or similar question exist, these have identified and retrieved regardless the geographical scope or time of production.

Types of participants

- People of any age targeted by routine vaccination programmes or campaigns.

Types of interventions

- Any intervention aiming at improving vaccination coverage by improving availability, accessibility, utilisation or effective coverage of vaccination services.
- In vaccination programmes of Switzerland, France, Germany, Italy and Austria reported in the last ten years or in SR without geographical or time limitations.
- Vaccines included: routine systematic vaccinations, in any formulation and presentation.
- Control: routine vaccination services or any other intervention used as comparator.

Types of outcome measures

- Vaccination status and vaccination coverage.

4.2 Search strategy for study identification

The following electronic bibliographic databases have been searched:

- Medline
- EMBASE
- PsycInfo
- Cochrane Library
- Web of science
- CINAHL

The WHO Global Health Library was not searched as it covers LMICs and also Global Health while European literature is mostly covered by Medline and Embase. PsycInfo was included to retrieve behavioural studies.

All references were imported into a reference manager software (Procite) which assigned unique, five-digits, identification numbers (Idn, Id number), which have been used along all processes in this review.

4.3 Inclusion, exclusion of references and data extraction

Hits from the search strategy have been assessed by looking at title and abstracts when titles were insufficient to decide. Resulting relevant studies where assessed against the inclusion criteria by a single reviewer. Occasional doubts where addressed by discussing with another reviewer involved in this project. At the stage of data extraction, some references were excluded, mainly because there were no quantitative estimates of the primary outcomes (see section 5.1).

Data from included references, both primary research and SR, was extracted by a single reviewer, using a template in MS Excel. The following data items were extracted:

- Id number: unique identification number for each reference.
- Author of the study or SR
- Year of publication
- Type of study design
- Sampling method
- Start of the study
- End of the study
- Country where the study took place
- Standard code of the country
- Geographical scope of the study (e.g. multicentre, national, sub-national)
- Setting where the study took place (e.g. community, health facility)
- Study population
- Ethnic group of the study population
- Socio-economic status (SES) of the study population
- Number of studies included (only SR)
- Type of intervention
- Detail of the intervention where available
- Type of control
- Detail of the control
- Vaccines
- Time when the outcomes where measured
- Type of measure used for the effect estimate of outcomes
- Numerator
- Denominator
- Lower precision bound
- Upper precision bound

4.4 Quality appraisal of included studies

The quality of included studies has not been assessed due to the limited scope of this review. This affects SR as well: while some of them assess the quality of the included studies others don't. We have not taken into account these assessments where present and we have neither assessed the quality of SR included in this review. Therefore, all findings are presented regardless the quality of the underlying evidence and study designs and should be interpreted with this in mind.

4.5 Analyses

Following the indications from the OFSP, interventions were grouped into the following eight categories:

1. Organization and coordination (simplification of processes and billing, strong national leadership, access to data, online vaccination file, alternative vaccination plans for people against vaccination, systematic reminders).
2. Vaccination supply (school vaccination, accessibility of provider, campaign providing easy access, visibility of providers).
3. Incentives to providers (law enforcement for cantons to provide it at school, financial incentives to providers including parents advisors).
4. Training.
5. Incentives for the population (legal basis in kindergarten or schools, free vaccination checks, incentives to target groups).
6. Information and communication (who provides the information, what, how, and coordination of communication).
7. Monitoring and evaluation (studies on vaccination coverage, research on perceptions, etc.).
8. Combination of any of the above.

The effects of interventions have been summarised using as much as possible standard measures of coverage change. Where possible results are presented in relative change; i.e. the change in coverage rate in the intervention groups divided by the change in coverage in the non-intervention groups; or relative changes in coverage rates over time, in time series studies. Where more than one change in coverage is reported (e.g. in different subgroups or different periods of time), the median relative change with ranges are presented. In studies where other comparable estimates were available (e.g. Odds Ratios (OR), or Relative Risks (RR)) these are transcribed with the precision measures used in the original study, usually 95% CI.

Actual effect estimates have been included in this report. We have not attempted to undertake any meta-analyses, due to the large diversity of interventions, outcomes and vaccines. However, we have synthesised the findings from included references to ease the interpretation of this literature review. Estimates have been categorised in four groups as follows (a symbol has been added to help the reading of tables; see section 5. Findings), using somehow arbitrary criteria:

Table 1. Criteria used to report the estimates of the effects of interventions, and symbols used.

	Criteria to define categories	Symbol used in tables
1)	Effects do not favour the intervention either because the point estimate is below 1 or because the lower precision estimate is below 1.	○
2)	Effects favour the intervention with an estimate below 2.	◉
3)	Effects favour the intervention with an estimate above 2 but with a lower precision estimate below 2.	⊙
4)	Effects favour the interventions with an estimate above 2 and an existing lower precision estimate above 2.	◎

4.6 Methodological notes

Some decisions have been taken in the course of working on this review which were not detailed in the protocol. These are the following:

- Against the protocol, all vaccines and ways of delivery have been included in order to offer a more complete description of the available evidence, and because this was not always clear in some references, and in some others vaccine delivery strategies were mixed.
- Against the protocol, all study designs have been included, provided they reported on changes in coverage attributable to an intervention.
- Only references reporting a quantitative estimate of effects on coverage or use of services have been included because inclusion of other outcomes would have complicated the presentation and interpretation of findings and are secondary to the objective of this review.
- Only SR (or parts of SR) with pooled estimates of more than one study have been included, because reports of single studies outside the Swiss geographical area would violate the inclusion criteria; and reports of single studies within the Swiss geographical area would have been retrieved within the primary research studies.
- Some SR embrace a wide range of interventions and may report the findings without distinguishing different types of interventions; in this case, the term “diverse” has been used;
- Controls were most commonly ‘usual care’; different controls have not been described because this would have multiplied the available combinations of interventions and outcomes, presented in the Findings section.
- Heterogeneity has not been estimated when preparing the synthesis of outcomes’ estimates.
- As stated above, no methodological quality of primary research or SR has been carried out.
- Multiplicity of studies in different SR has not been cross-checked.

5 Findings

5.1 Results from search strategies

A total of 10,942 references have been identified applying the search strategy across the priority groups and in the different literature databases. See Table 4 for details. These included 4,585 primary research studies, 6,134 SR and 223 non-priority studies, according to the protocol.

Figure 1 and Figure 2 depict the trees with the selection process of references for primary research studies and SR, respectively. In both cases, a large proportion of references were deemed as irrelevant which is consistent with the high sensitivity of the search strategy. Some of the common reasons for exclusion included:

- effectiveness studies of vaccines on health outcomes;
- studies on risk factors for vaccination or unvaccination;
- experimental studies related to the development of vaccines;
- studies dealing with other health related areas but mentioning in one way or another immunisation or vaccination;
- studies focusing on vaccine preventable diseases.

Figure 1. Tree showing the selection of references of primary research studies.

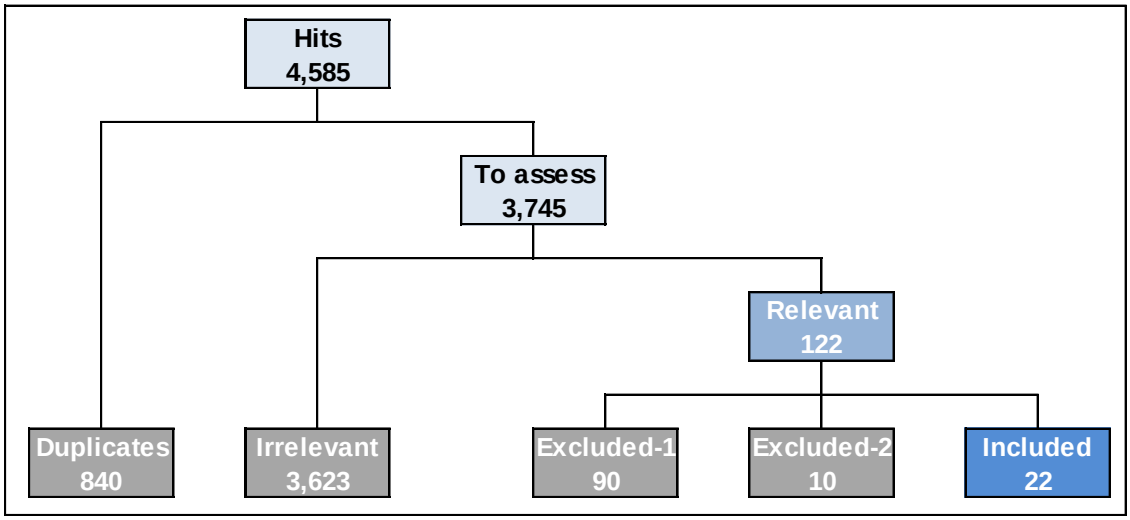
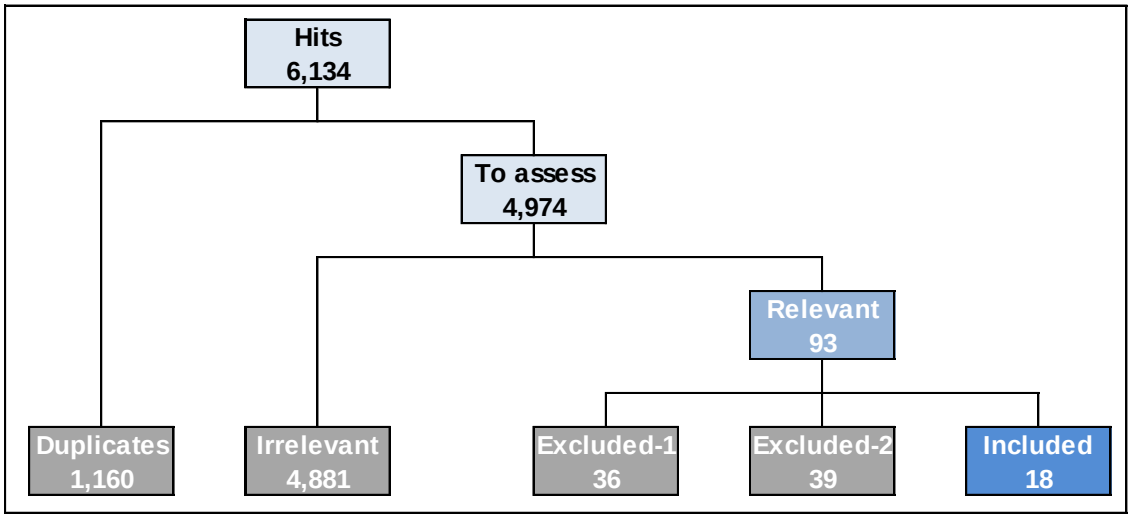


Figure 2. Tree showing the selection of references of systematic reviews.



122 relevant references from Switzerland or neighboring countries were considered relevant, of which 90 were excluded in the first round on the grounds of obvious discrepancies with the inclusion criteria. At the stage of data extraction, ten other references were excluded. These references and the reasons for exclusion can be found in Table 5 (Annex 3).

93 SR were classified as relevant, of which 36 were excluded in the first round and a further 39 at the stage of data extraction. Excluded SR and reasons for exclusion can be found in Table 6 (Annex 3).

Other reviews known to us could not be included because they are currently under development; these are:

- Kaufman J, Synnot A, Hill S, Willis N, Horey D, Lin V, Ryan R, Robinson P. Face to face interventions for informing or educating parents about early childhood vaccination (Protocol). Cochrane Database of Systematic Reviews 2012, Issue 8. Art. No.: CD010038. DOI: 10.1002/14651858.CD010038.
- Saeterdal I, Glenton C, Austvoll-Dahlgren A, Munabi-Babigumira S, Lewin S. Community-directed interventions for informing and/or educating about early childhood vaccination (Protocol). Cochrane Database of Systematic Reviews 2012, Issue 11. Art. No.: CD010232. DOI: 10.1002/14651858.CD010232.

Another review known to us was not retrieved in the outputs of the search strategy; it was included in a first stage but then excluded because it did not contain quantitative data on vaccination outcomes (Grilli 2002).

5.2 Included references

Included references of primary research studies and SR are listed in Table 7 and Table 8, respectively (Annex 4).

5.2.1 Primary studies

22 primary research studies were included, published between 1997 and 2012: nine were from Switzerland, six from France, another six from Germany and one from Italy. Study designs included eight CBA (some of them of doubtful design), six were observational studies, four ITS, three RCT and one study design could not be defined. Most of the studies took place in hospital settings (9 studies), and others in the community (6), Primary Health Care settings (3), schools (2), a maternity (1) or the setting was undefined (1).

In terms of interventions: one study reported an organisational or governance intervention (i.e. vaccination programme in a maternity), five reported supply interventions (e.g. vaccination campaign or providing vaccination at the work place), 11 studies dealt with information / communication interventions (e.g. letters and reminders) and five studies reported on combinations of interventions (e.g. leaflets and posters with training). No studies carried out in Switzerland or neighbouring countries reported single interventions in the areas of incentives to providers, training, incentives to the population or monitoring and evaluation.

More than half of studies had influenza vaccination as outcome (12); four studies reported on several vaccines, two reported on MMR; pertussis and BCG, one each, one more reported on vaccines refunded and another one on Hepatitis B vaccine (HBV) immune-response. See Table 7 and Table 9 for further details.

5.2.2 Systematic reviews

The 18 included SR were published between 1996 and 2012. Since SR are based on a large variety of study designs, health systems settings and geographical areas, the description of these features depends on the level of detail of the SR extracting this information from the underlying studies included. Studies settings included rural and urban areas and all sorts of health care levels (i.e. from community and primary care to hospitals) with participants ranging from children to the elderly.

The number of studies included in the SR (or in the parts of the SR reporting vaccination outcomes) varied greatly: from one to 68 (Batt 2004, 00621); in one review (Shea 1996, 10284) it was not possible to ascertain how many studies were included.

Interventions and outcomes are reported based on the whole or parts of SR because some SR include several interventions and report separately for each intervention or group of interventions and outcomes. Therefore, the total number of intervention-outcomes dyads is larger than the number of SR included in this review.

Interventions assessed were organisational (e.g. entry requirements for vaccination) in two SR, related to vaccine supply (e.g. home visits) in two SR, to providers' incentives (e.g. pay for performance) in three SR, to training (e.g. audit and feed-back, education) in seven SR, to population incentives (e.g. reducing the costs of vaccines to families) in three SR and to information and communication (e.g. reminders, standing orders) in 10 SR. Seven SR reported combinations of interventions (e.g. combinations of provider and client demand). Note that the number of SR is larger than 19 because a SR can include more than one intervention. No SR reported on monitoring and evaluation interventions. It is worth to note that in some SR interventions were not described in detail.

SR hardly focused on specific vaccines, and in several cases considered very different age groups, as well. This is due to the inclusion of studies which have in common the type of intervention to asses, but not necessarily the vaccines considered for measuring the outcomes. For this reason, the type of vaccine is not reported, although this information has been extracted when available.

5.3 Effects of interventions in primary studies

Regardless the quality of the primary studies, most of them showed modest to no improvement in vaccination outcomes. The most remarkable effects were those reported in Harbarth 1998 (04219), an observational study of a complex health system intervention (educational conferences; nurse taking vaccines to wards, clinics, and conferences; letter to HCWs with pay check). The study, carried out in Switzerland in 1998 reports changes in influenza coverage among health care workers between two seasons with a relative increase of 2.56 (in some parts of a hospital) and 2.85 (in some other parts of a hospital).

Another study (Durand 2011, 00316) assessed two interventions in France: information and vaccine prescription for both parents at discharge from the maternity and vaccination proposed to both parents during hospitalization in maternity. The relative changes in pertussis coverage for both interventions were 6.63 and 7.11 respectively (median 6.87).

The only study which assessed an organisational intervention (Parache 2012, 00325) showed that a vaccination programme introduced in a French maternity produced a relative increase of BCG coverage of 1.23 but vanished when measured elsewhere with a relative change of 0.53 (median 0.88).

Interventions affecting the supply of vaccines or way of delivery were more promising in general: vaccination campaigns (Roth-Kleiner 1997, 04221), included in hospital care, as mentioned above, and a nurse vaccination programme for HIV positive patients (Boillat Blanco 2011, 03237) showed positive effects. However, these studies are quite specific in terms of settings and recipients.

The largest group of studies was the one assessing the effects of information and communication interventions and, therefore, this group was more likely to show a wide variety of results. Information targeting users showed mixed effects. The most remarkable one was a study looking at the effects of TV spots, press conferences, information to health professionals, an Internet site, leaflets, posters to improve influenza vaccination status of the elderly (Toscani 2003, 05539). On the other hand, information and communication interventions targeting providers were very effective in the study of (04219) evaluating the effects of educational conferences, nurses taking vaccines to wards, clinics, and conferences together with educational measures (e.g. letter to HCWs with pay check) attended by HCW. Other studies showed smaller effects; for example, the use of medical students to inform about influenza vaccination (Birchmeier 2001, 01804, in Switzerland) with a relative change of 1.58%; or an intervention to develop a sense of altruism among health workers (Rothan-Tondeur 2010, 00039 in France), rate ratio of 0.95.

Table 2. Synthesis of findings from primary research studies.

Effects					Outcome						
Interventions OFSP	**Detail**	**Study population**	**Idn**	**Code**	**Influenza (coverage)**	**MMR 1,2 (coverage)**	**Pertussis (coverage)**	**BCG (coverage)**	**Several (coverage)**	**Vaccines refunded**	**HBV immune-response**
Organisation	Vaccination programme in maternity.	Infants at risk of contracting TB	00325	FRA				O			
Supply	Vaccination campaign.	Classes 1, 2, 7 and 8	04221	CHE					⊙		
	Free vaccination at workplace; information materials; campaign.	Hospital staff	03231	CHE	O						
	Health check as preclinical students.	Medical students	09514	DEU					O		
	I1: information and vaccine prescription for both parents at discharge from the maternity. I2: vaccination proposed to both parents during hospitalization in maternity.	New-borns	00316	FRA			◎				
	Nurse vaccination program.	HIV+	03237	CHE							⊙
Information / communication	Involve HCWs in the creation of "safety zones"; reward wards showing increased vaccination coverage; slide show, posters, two booklets/leaflets, and rubber bracelets.	HCWs	01941	FRA	O						
	HRA and group session or home visit.	> 59 years old	02047	DEU					⊙		
	Letter to parents about the need of vaccination.	Pupils 6 and 9th grade	01280	DEU					O		
	Medical student informing (prevention and complications) and proposing an influenza vaccination before patient met the doctor.	Above 64 years old	01804	CHE	O						
	Letter and then a phone call to get vaccination status. If MMR not complete, persuasion talk.	Children entering school	10262	DEU		O					
	Posters, hand-outs; text suggestions for employee mailings; list of suggested activities to increase influenza vaccination among HCW.	HCWs	03008	DEU	O						

Effects					Outcome						
Interventions OFSP	**Detail**	**Study population**	**Idn**	**Code**	**Influenza (coverage)**	**MMR 1,2 (coverage)**	**Pertussis (coverage)**	**BCG (coverage)**	**Several (coverage)**	**Vaccines refunded**	**HBV immune-response**
	Week of vaccination with community healthcare professionals; media campaign, visits to local physicians, training, posters, booklets, exhibition.	Communities	09635	FRA						O	
	TV spots, press conferences, information to health professionals, Internet site, leaflets, posters to risk groups.	Above 64 years old	05539	CHE	⊙						
	Information to develop a sense of altruism in HCWs.	HCWs	00039	FRA	O						
	information-meetings (e.g. leaflets, videos, local TV) about vaccination among associations for the elderly and for staff of socio-medical institutions.	Above 64 years old	02771	CHE	O						
	Educational conferences; nurse taking vaccines to wards, clinics, and conferences; educational measures (e.g. letter to HCWs with pay check) attended by HCW.	HCWs	04219	CHE	◎						
[Combination]	Leaflets, posters; walk-in vaccination clinic; training workshop for MDs; record reminders and peer comparison on vaccination performance; reminder stickers for medical records.	Above 64 years old	01238	CHE	⊙						
	Letter addressing misconceptions found in a preceding survey; educational conversation with head nurses ; more "walk-in" vaccination clinics; vaccination in the wards.	HCWs	10273	CHE	O						
	Information sessions with vaccination offered on the spot.	HCWs	05094	FRA	⊙						
	Education by peer key persons as educators; local vaccination stations.	Children entering school	01279	DEU		O					
	Coordination, providers' incentives, vaccination in general practices, health information.	> 65 years	05265	ITA	O						

All studies assessing combination of interventions consistently showed moderate to large effects. For example, Humair 2001 (01238, in Switzerland) showed large effects (relative benefit of 2.6) of using a combination of leaflets, posters, a walk-in vaccination clinic, training workshops for medical doctors, recording reminders, peer comparisons on vaccination performance, and reminder stickers for medical records; Dunais 2006 (05094, in France) assessed information sessions with vaccination offered on the spot, with a relative change in coverage of 8.71%.

The effects of interventions from primary research studies are synthesised in Table 2 and detailed in Table 9.

5.4 Effects of interventions in systematic reviews

Effects reported in SR were varied as well by intervention, and no single intervention or group of interventions showed definitive results. Several reviews suggested relatively large effects. One review (Shefer 1999, 10503) reports on at least 11 different interventions, showing large effects of interventions determining the entry requirements to vaccination programmes (three studies, 15% absolute increase in coverage), use of standing orders (11 studies, 51% increase), incentives to users (3 studies, 8% change) and combined interventions for women, children and infants (4 studies, 9% change). Stone 2002 (00272) assessed a series of interventions to increase adult immunisation and cancer screening services.

Interventions with significant effects in improving coverage included: organisational interventions (i.e. changes in the work processes in a medical care organization such as addition or redesign of jobs, changes in clinical procedures, or changes in facilities or infrastructure) (adjusted OR 16, 95% CI: 11.20 to 22.80), education to providers (3.21, 2.24 to 4.61), reminders to providers (3.80, 3.31 to 4.37), reminders targeting users (2.52, 2.24 to 2.82) and financial incentives for users (3.42, 2.89 to 4.06). In general, organisational interventions tended to have large effects (Shefer 1999 (10503) and Stone 2002 (00272).

Two interventions were studied in the group of supply or ‘way of delivery’: home visits in three SR, and interventions to improve access, in general, in one review. Results for home visits varied from 10% (range -1% to 40%) median coverage change in Shefer 1999 (10503) to 3.29 (95%CI 1.91 to 5.66) relative change in coverage in Thomas 2010 (03635). The effects of access interventions assessed by Shefer 1999 (10503) were a median change in coverage of 10% (range -8.0 to 35.0%).

Interventions related to training of human resources or the type of human resources delivering vaccines showed mixed results or conflicting results. For example, feed-back in Bordley 2000 (00192) showed absolute changes in coverage ranging from -4% to 49%, but in Williams 2011 (03379, in LMIC) effects were much larger, 19%. The use of lay health workers to deliver vaccination services suggested modest effects (RR 1.19, 95% CI 1.09 to 1.30 in Glenton 2011 (2807); and 1.21, 1.07 to 1.37 in Lewin 2010 (00875), two reviews which are related).

Three reviews looked at financial resources targeting providers (incentives, pay for performance and payments to physicians): adjusted OR of 1.26 (Stone 2002, 00272), only a significant p value reported in Houle 2012 (00264) and OR 2.22 Thomas 2010 (03635), respectively. Stone 2002 (00272) looked as well at financial incentives to users suggesting positive effects on coverage (adjusted OR 3.42, 95% CI 2.89 to 4.06).

Incentives to the population showed some examples of large effects: in Shefer 1999 (10503) incentives produced a median coverage change of 8% (range 5% to 15%) and financial incentives assessed in Stone 2002 (00272) found a relative change in the use of services of 3.42 (95%CI 2.89 to 4.06). Only the reduction of the costs of vaccines to families (Shefer 1999 (10503) showed a median coverage change ranging from -8.0% to 47%.

A larger number of SR, or parts of SR, looked at information interventions within the systems, with very heterogeneous results (e.g. reminders and recalls for providers: absolute change 10% ranging

from -2% to 33% in Williams 2011, 03379) and large effects (see above). A review which does not report the number of studies included reported large effects (Shea 1996, 10284). A series of information interventions targeting users were studies in Jacobson 2005 (03971): postcard reminder, letter reminder, phone reminder, autodialer reminder, card and phone reminder, patient reminder, tracking and outreach. All interventions showed modest albeit significant improvements, except the last one (OR from 1.29 to 1.92).

As expected, a number of SR reported on combinations of interventions which cannot easily be classified in any of the subgroups. These interventions typically combine user or client targeted interventions with provider or system interventions. For example, a review which combines access and user targeted interventions suggested relatively large effects with absolute changes of 14%, range 3.10% to 46% (reported in Ndiaye 2005 (00194) and also in Willis 2005 (10504)). There does not seem to be an emerging pattern on the effects of combined interventions. For example, a potentially promising combination of provider based, demand and access interventions suggested effects in a very large range with a median change in coverage of 22.8%, ranging from -5.9% to 67% (Ndiaye 2005 (00194), 4 studies included).

The effects of interventions reported in SR or parts of SR are synthesised in Table 3 and detailed in Table 10.

Table 3. Synthesis of findings from systematic reviews.

Effects				**Outcome**
Interventions OFSP	**Detail**	**Idn**	**Studies**	**Diverse**
Organisation	Entry requirements.	10503	3	◎
	Assessment and feed-back.	10503	14	⊙
	Organisational change.	00272	29	◎
Supply	Home visits.	10503	7	O
		03635	2	⊙
	Access interventions.	10503	16	O
	Home visiting.	04102	9	O
Incentives providers	Incentives.	00272	29	O
	Pay for performance.	00264	2	O
	Payment to physicians.	03635	2	⊙
			3	⊙
Training	Audit and feed-back.	00192	10	O
	Education.	00272	29	◎
	Feed-back.	03379	4	◎
	Lay Health Workers.	00875	6	O
		02807	4	O
	Provider education.	03379	4	⊙
	Encouragement.	03635	3	O
Incentives population	Incentives.	10503	3	◎
	Reducing the costs of vaccines to families.	10503	26	O
	Financial incentives.	00272	29	◎
	Free vs. Invitation and payment.	03635	2	O
	Free vs. no intervention.	03635	2	⊙
Information / communication	Education combined with reminders, access, costs, WIC, records, incentives, feed-back, home visits.	10503	15	O
	Reminders, recall.	10503	29	⊙
			42	O

Effects				Outcome
Interventions OFSP	**Detail**	**Idn**	**Studies**	**Diverse**
	Standing orders.	10503	11	◎
	Reminders.	00194	7	○
		00272	29	□
	Education.	00272	29	●
		03635	13	●
	Feed-back.	00272	29	●
	Reminders and recall.	03379	5	○
			22	○
	Reminder and recall (not tailored).	03635	13	⊙
	Reminder and recall (tailored).	03635	11	●
	Reminder to provider.	03635	2	◎
	Postcard reminder.	03971	6	●
	Letter reminder.	03971	20	●
	Phone reminder.	03971	4	●
	Autodialer reminder.	03971	4	●
	Card and phone reminder.	03971	5	●
	Patient reminder.	03971	35	●
	Tracking and outreach.	03971	2	●
	Physician reminders.	04158	3	◎
	Computer reminder.	10284	Not available	◎
	Manual reminder.	10284	Not available	⊙
	Computer and manual reminder.	10284	Not available	◎
	Diverse	03623	8	○
[Combination]	Women, infants, children	10503	4	◎
	Client demand, provider-based intervention.	00194	5	○
	Client demand, access.	00194	9	◎
	Provider-based, access.	00194	3	○
	Provider-based, access, demand.	00194	4	○
	Patient focused	02176	6	●
	Provider focused	02176	4	⊙
	Mixed	02176	6	⊙
	Patient and provider reminder.	03971	4	⊙
	Access, provider, user.	10504	4	○
	Access and user.	10504	9	◎
	Diverse	00621	68	○
	Diverse (on influenza)	05908	65	●
	Diverse (on pneumococcal)	05908	35	⊙

6 Interpretation and conclusions

What have we done?

- We have reviewed the available research evidence of interventions to improve vaccination coverage looking at primary research studies from Switzerland and its neighbouring countries published in the last 10 years and at SR with no year of publication or geographical limitations. A highly sensitive search strategy was designed in order to minimise the risk of missing any relevant evidence.

What are the precautions in interpreting the evidence?

- The available evidence has to be interpreted with caution because some of the studies are observational and more prone to bias and the quality of studies has not been assessed.
- Moreover, in the process of compiling this review a few obvious quality issues emerged in several reviews, such as missing information, incomplete reporting of outcomes and some data inconsistencies (e.g. a report of a median change of 19% with an upper limit of the estimate of 19% as well, which is not consistent; Williams 2011, 03379).
- On the other hand, we have not checked systematically for duplicate publication of the same studies, SR or parts of SR, although some cases have been identified (e.g. Ndiaye 2005 (00197) and Willis 2005 (10504)).
- The interventions most widely reported are those related to information to users (e.g. reminders, dissemination of information materials); therefore, it is more likely to find studies with positive effects in these interventions. It is equally important to look at evidence suggesting low effectiveness to avoid the impression that these interventions work better just because there are more examples of positive effects attributed to them. A second group of interventions widely addressed are those which combine different strategies, which neither in the primary research studies nor in SR show any clear advantage in terms of their effects on vaccination coverage.
- A caveat of any attempt to summarise evidence on the effects of interventions is the limited description of the implementation details of interventions in the source studies. This limits the external validity of the findings and calls for a careful interpretation of the available evidence.

What does this review say?

- Interventions to improve coverage tend to have modest effects, with large effects being occasional and may be subject to bias.
- All groups of interventions have examples of modest effects, or no effects or even negative effects on vaccination coverage.
- Organisational interventions studies in SR show promising findings, only contested by a single primary study conducted in France.
- The most effective ways of delivery or ‘supply’ were those which would seem more proactive, such as campaigns or approaching parents in wards; other interventions including home visits had heterogeneous results.
- In SR, effects of incentives for providers tend to be smaller than the effects of incentives for the population, with more examples of larger effects in the latter.
- Information-related interventions have been the most widely reported and include a wide range of strategies and information dissemination materials. At least one review showing promising findings dealt with mass media.

- Educational interventions targeting users were less reported showing very modest findings except for a single study with a complex educational intervention involving health care staff.
- There was no evidence on monitoring and evaluation interventions, probably because it would be hard to demonstrate linkages between these types of interventions and changes in coverage; these studies would rather look at factors associated to vaccination, which were excluded from this review.

How can this review be used?

- SR or parts of SR with promising interventions relevant to the Swiss context should be further scrutinised to assess their quality, external validity and implementation issues. This evidence should be matched with that from primary research carried out in Switzerland or its neighbouring countries. Interventions to consider:
    - organisational interventions;
    - incentives to the population;
    - education, information and communication to users and providers.
- Relevant evidence (mostly qualitative) on health systems level interventions to strengthen immunisation programmes should be considered as a complement to this review. This review would provide evidence in the following related aspects:
    - Health information system (e.g. reminders)
    - Health workers tasks arrangements (e.g. delivery of vaccination by lay health workers)
    - Health workers incentives (e.g. financial)
- The 'supply' or ways of delivery of vaccinations and access interventions (except for the obvious effects of campaigns and other proactive strategies) should be looked from the local perspective of the Swiss context, probably based on the known determinants of low vaccination in Switzerland.
- Reports of combined interventions should be treated separately and used:
    - to generate ideas on types of interventions to consider in Switzerland;
    - to support the evidence of studies addressing single interventions.

ANNEXES

Annex 1. Search strategy

1 immunization/ (2322)
2 (vaccin* or revaccinat* or immuniz* or immunis* or immunotherap* or inoculat* or innoculat*).ti,ab. (6474)
3 1 or 2 (6534)
4 switzerland.ti,ab. (2545)
5 (austria or france or germany or italy or liechtenstein).ti,ab. (25034)
6 (Andorra or Austria or Belgium or "Channel Isles" or "Channel Islands" or Croatia or Cyprus or "Czech Republic" or Denmark or Estonia or Faroes or "Faroe Islands" or "Faeroe Islands" or Finland or France or Germany or Greece or Hungary or Iceland or Ireland or Eire or "Isle of Man" or Italy or Liechtenstein or Luxembourg or Malta or Monaco or Netherlands or Norway or Poland or Portugal or "Slovak Republic" or Slovakia or Slovenia or Spain or Sweden or Switzerland or Britain or "Great Britain" or "United Kingdom" or UK or England or Wales or Scotland or "Northern Ireland" or "western europe").ti,ab. (109487)
7 ("randomized controlled trial" or "randomised controlled trial" or "controlled clinical trial" or "random* allocat*" or trial or multicenter or "multi center" or multicentre or "multi centre" or intervention* or controlled or "control group" or (before adj5 after) or (pre adj5 post) or pretest or "pre test" or posttest or "post test" or quasiexperiment* or "quasi experiment*" or "time series" or "time point*" or "repeated measur*").ti,ab. (397432)
8 exp clinical trials/ (6560)
9 7 or 8 (398871)
10 3 and 4 and 9 (4)
11 3 and 5 and 9 (18)
12 3 and 6 and 9 (66)
13 limit 12 to yr="1860 - 2001" (5)
14 ("systematic review" or "meta-analy*" or metaanaly*).ti,ab. (21112)
15 "Systematic Review".md. (6613)
16 "Meta Analysis".md. (10003)
17 14 or 15 or 16 (23875)
18 3 and 17 (64)
19 limit 12 to yr="2002 -Current" (61)

Annex 2. Results from the search strategy.

Table 4. Classification of search strategies and hits.

Group	Type of research	Geographical scope	Date of publication	Medline	EMBASE	PsycInfo	Cochrane Central	Web of science	CINAHL	Total
1	Primary research	Switzerland	2002-2013	90	172	4		89	12	**367**
2	Systematic reviews	Any place	Any time	871	2,682	64		1,960	557	**6,134**
3	Primary research	Switzerland	Prior to 2002	88	99	(4)	12	38	5	**242**
4	Primary research	Germany, France, Italy, Austria, Lichtenstein	2002-2013	1,102	1,847	18	62	843	104	**3,976**
6	Primary research	Western Europe	2002-2013			(61)	223			**223**
	Total			**2,151**	**4,800**	**86**	**297**	**2,930**	**678**	**10,942**

In this report we have prioritised primary research from groups 1, 3 and 4, and systematic reviews in group 2. However, references from all groups are available.

Annex 3. Post-hoc exclusions

Table 5. Excluded references of primary studies with reasons for exclusion.

N	Id	Reference	Reasons for exclusion
1	09900	Bader H.M., Egler P. Immunisation coverage in the adult workforce 2003. Utilisation of routine occupational health checks to ascertain vaccination coverage in employees. [German]. Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz. 47 (12) (pp 1204-1215), 2004. Date of Publication: Dec 2004.	No data to enable comparisons.
2	01322	Conner M, Godin G, Norman P, Sheeran P. Using the Question-Behavior Effect to Promote Disease Prevention Behaviors: Two Randomized Controlled Trials. Health Psychol 2011; 30(3).	Outside geographical scope (UK).
3	05338	Conversano M, Minerba S, Pesare A. [Decentralization of vaccination intervention: synergy between LHU and General practitioners]. [Italian]. Ann Ig 2002; 14(3 Suppl 3).	No data to enable comparisons.
4	02506	D'onofrio A, Manfredi P, Poletti P. The Interplay of Public Intervention and Private Choices in Determining the Outcome of Vaccination Programmes. Plos One 2012; 7(10).	No intervention assessed.
5	03002	Kunze M, Kunze U. Social Marketing and the Establishment of the Isw-Tbe. Vaccine 2003; 21.	No intervention assessed.
6	09160	Marino M.G., Pandolfi E, Carloni E, Ciofi degli Atti M, Tozzi A.E. V+: strategies improving vaccination coverage among children with chronic diseases. [Italian]. Igiene e Sanita Pubblica. 65 (2) (pp 189-199), 2009. Date of Publication: 2009 Mar-Apr.	No data on outcomes.
7	01307	Prati G, Pietrantoni L, Zani B. Influenza Vaccination: the Persuasiveness of Messages Among People Aged 65 Years and Older. Health Communication 2012; 27(5).	No data reported.
8	10456	Stathopoulou HG, Skourti IG. Health care workers' participation in influenza vaccination programs. Application of the PRECEDE- PROCEED mode. Health Science Journal , 2010; 4 (3).	No intervention assessed (literature review).
9	00645	Wicker S, Rabenau HF, Gottschalk R, Krause G, Mclennan S. Low Influenza Vaccination Rates Among Healthcare Workers. Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz 2010; 53(12).	No intervention assessed.
10	08248	Woringer V. Factors influencing vaccination acceptance against Hepatitis B at school and assessment of general vaccination coverage. Soz Praventivmed 45 (6) (pp 267-273), 2000. Date of Publication: 2000.	No data to enable comparisons.

Table 6. Excluded references of systematic reviews with reasons for exclusion.

N	Id	Reference	Reasons for exclusion
1	00254	Anderson LA, Janes GR, Jenkins C. Implementing Preventive Services: to What Extent Can We Change Provider Performance in Ambulatory Care? A Review of the Screening, Immunization, and Counseling Literature. Ann Behav Med 1998; 20(3).	No quantitative data on outcomes of interest (only behavioural)
2	03408	Arditi C, Rege-Walther M, Wyatt JC, Durieux P, Burnand B. Computer-generated reminders delivered on paper to healthcare professionals; effects on professional practice and health care outcomes. [Review]. Cochrane Database of Systematic Reviews. 2012; 12:CD001175, 2012.	No data for specific vaccination outcomes.
3	01316	Atun R, De Jongh T, Secci F, Ohiri K, Adeyi O. A Systematic Review of the Evidence on Integration of Targeted Health Interventions Into Health Systems. Health Policy Plan 2010; 25(1).	Narrative summary of individual studies.
4	03416	Berkman ND, Sheridan SL, Donahue KE *et al*. Health literacy interventions and outcomes: an updated systematic review. [Review]. Evidence Report/Technology Assessment. 2011; (199).	No vaccination data.
5	10377	Bhutta ZA, Darmstadt GL, Hasan BS, Haws RA. Community-based interventions for improving perinatal and neonatal health outcomes in developing countries: a review of the evidence. Pediatrics , 2005 Feb; 115 (2 Part 2).	Vaccination is the intervention.
6	01376	Bonanni P, Levi M, Latham NB *et al*. An Overview on the Implementation of Hpv Vaccination in Europe. Human Vaccines 2011; 7.	Generic review of programmes; no outcomes reported.
7	02878	Bryson M, Duclos P, Jolly A, Bryson J. A Systematic Review of National Immunization Policy Making Processes. Vaccine 2010; 28.	Only qualitative.
8	07234	Doggett C, Burrett S, Osborn D.A. Home visits during pregnancy and after birth for women with an alcohol or drug problem. Cochrane Database of Systematic Reviews (Online). (4) (pp CD004456), 2005. Date of Publication: 2005.	Only one primary studies, out of scope.
9	01599	Eisend M. Two-Sided Advertising: a Meta-Analysis. International Journal of Research in Marketing 2006; 23(2).	No vaccination outcomes.
10	03377	Eisner D, Zoller M, Rosemann T, Huber CA, Badertscher N, Tandjung R. Screening and prevention in Swiss primary care: a systematic review. International Journal of General Medicine. 2011; 4:853-70, 2011.	Studies on factors (but barriers), Switzerland.
11	00244	George PP, Molina JAD, Cheah J, Chan SC, Lim BP. The Evolving Role of the Community Pharmacist in Chronic Disease Management - a Literature Review. Annals Academy of Medicine Singapore 2010; 39(11).	No quantitative data on outcomes of interest.
12	10744	Giuffrida A, Gosden T, Forland F *et al*. Target payments in primary care: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews , 1999 (4).	Only individual primary studies, out of scope.
13	07854	Gosden T, Forland F, Kristiansen I.S. *et al*. Impact of payment method on behaviour of primary care physicians: A systematic review. J Health Serv Res Policy 6 (1) (pp 44-55), 2001. Date of Publication: 2001.	Only individual primary studies, out of scope; partially narrative.
14	90001	Grilli R, Ramsay C,Minozzi S. Massmedia interventions: effects on health services utilisation. CochraneDatabase of Systematic Reviews 2002, Issue 1. Art. No.: CD000389. DOI: 10.1002/14651858.CD000389.	No quantitative data.
15	01895	Hinman AR, Orenstein WA, Williamson DE, Darrington D. Childhood Immunization: Laws That Work. Journal of Law Medicine & Ethics 2002; 30(3).	Only qualitative.

N	Id	Reference	Reasons for exclusion
16	01654	Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of Computer-Based Clinical Decision Support Systems on Physician Performance and Patient Outcomes - a Systematic Review. Jama-Journal of the American Medical Association 1998; 280(15).	No vaccination outcomes.
17	02974	Hyde TB, Dentz H, Wang SA, Burchett HE, Mounier-Jack S, Mantel CF. The Impact of New Vaccine Introduction on Immunization and Health Systems: a Review of the Published Literature. Vaccine 2012; 30(45).	Only qualitative.
18	01312	Jackson C, Cheater FM, Reid I. A Systematic Review of Decision Support Needs of Parents Making Child Health Decisions. Health Expectations 2008; 11(3).	Only qualitative.
19	00592	Kinnersley P, Edwards A, Hood K *et al*. Interventions Before Consultations to Help Patients Address Their Information Needs by Encouraging Question Asking: Systematic Review. Br Med J 2008; 337(7665).	No vaccination data.
20	03851	Lagarde M, Haines A, Palmer N. Conditional cash transfers for improving uptake of health interventions in low- and middle-income countries: a systematic review. [Review] [30 refs]. JAMA 2007; 298(16).	Only individual primary studies, out of scope.
21	03322	Nutman S, McKee D, Khoshnood K. Externalities of prevention of mother-to-child transmission programs: a systematic review. AIDS & Behavior. 2013; 17(2).	No pooled data.
22	01305	O'keefe DJ, Nan XL. The Relative Persuasiveness of Gain- and Loss-Framed Messages for Promoting Vaccination: a Meta-Analytic Review. Health Communication 2012; 27(8).	Comparison of gain- and loss-framed appeals.
23	10530	Oyo-Ita A, Nwachukwu CE, Oringanje C, Meremikwu MM. Interventions for improving coverage of child immunization in low- and middle-income countries. Cochrane Database of Systematic Reviews , 2011 (7).	Only individual primary studies, out of scope.
24	00495	Pereira JA, Quach S, Heidebrecht CL *et al*. Barriers to the Use of Reminder/Recall Interventions for Immunizations: a Systematic Review. Bmc Medical Informatics and Decision Making 2012; 12.	Study of factors (barriers to the implementation of interventions).
25	03607	Police RL, Foster T, Wong KS. Adoption and use of health information technology in physician practice organisations: systematic review. [Review]. Informatics in Primary Care. 2010; 18(4).	Studies on factors.
26	03079	Robbins SCC, Ward K, Skinner SR. School-Based Vaccination: a Systematic Review of Process Evaluations. Vaccine 2011; 29(52).	No pooled data; partially narrative.
27	02175	Roter DL, Hall JA, Merisca R, Nordstrom B, Cretin D, Svarstad B. Effectiveness of Interventions to Improve Patient Compliance - a Meta-Analysis. Med Care 1998; 36(8).	No data for specific vaccination outcomes.
28	00449	Ryman TK, Dietz V, Cairns KL. Too Little but Not Too Late: Results of a Literature Review to Improve Routine Immunization Programs in Developing Countries. Bmc Health Services Research 2008; 8.	Paucity of data from single studies in LMIC.
29	03547	Scott A, Sivey P, Ait Ouakrim D *et al*. The effect of financial incentives on the quality of health care provided by primary care physicians. [Review]. Cochrane Database of Systematic Reviews. 2011; (9).	Only one study, out of scope.
30	00493	Shea B, Andersson N, Henry D. Increasing the Demand for Childhood Vaccination in Developing Countries: a Systematic Review. Bmc International Health and Human Rights 2009; 9.	Overview of reviews reporting on individual studies.
31	01435	Souza NM, Sebaldt RJ, Mackay JA *et al*. Computerized Clinical Decision Support Systems for Primary Preventive Care: a Decision-Maker-Researcher Partnership Systematic Review of Effects on Process of Care and Patient Outcomes. Implementation Science 2011; 6.	Qualitative indicators and for individual studies only.

N	Id	Reference	Reasons for exclusion
32	00604	Sullivan F, Mitchell E. Has General-Practitioner Computing Made a Difference to Patient-Care - a Systematic Review of Published Reports. Br Med J 1995; 311(7009).	Outcomes out of scope (consultation processes).
33	10664	Toronto CE, Mullaney SM. Registered nurses and influenza vaccination: an integrative review. AAOHN J , 2010 Nov; 58 (11).	Study on factors.
34	00197	Town R, Kane R, Johnson P, Butler M. Economic Incentives and Physicians' Delivery of Preventive Care - a Systematic Review. Am J Prev Med 2005; 28(2).	No quantitative data on outcomes of interest.
35	05889	Wallace A.S., Ryman T.K., Dietz V. Experiences integrating delivery of maternal and child health services with childhood immunization programs: Systematic review update. J Infect Dis 205 (SUPPL. 1) (pp S6-S19), 2012. Date of Publication: 01 Mar 2012.	Only individual primary studies, out of scope.
36	00389	Ward K, Chow MYK, King C, Leask J. Strategies to Improve Vaccination Uptake in Australia, a Systematic Review of Types and Effectiveness. Aust N Z J Public Health 2012; 36(4).	No pooled data and outcomes out of scope.
37	10550	Whittaker K. Lay workers for improving the uptake of childhood immunization. British Journal of Community Nursing , 2002 Sep; 7 (9).	Only individual primary studies, out of scope; more recent evidence available.
38	00899	Witter S, Fretheim A, Kessy FL, Lindahl AK. Paying for Performance to Improve the Delivery of Health Interventions in Low- and Middle-Income Countries. Cochrane Database of Systematic Reviews 2012; (2).	Reporting only individual studies.

Annex 4. Included references.

Table 7. Included primary studies.

N	Id	Reference
1	09635	Baudier F, Tarrapey F, Leboube G. Pilot campaign to promote vaccination: description preliminary results of a regional French program. [French]. Medecine Et Maladies Infectieuses. 37 (6) (pp 331-336), 2007. Date of Publication: June 2007.
2	01804	Birchmeier M, Favrat B, Pecoud A *et al*. Improving Influenza Vaccination Rates in the Elderly. J Fam Pract 2002; 51(10).
3	03237	Boillat Blanco N, Probst A, Da Costa VW *et al*. Impact of a nurse vaccination program on hepatitis B immunity in a Swiss HIV clinic. Journal of Acquired Immune Deficiency Syndromes: JAIDS. 2011; 58(5).
4	02047	Dapp U, Anders JA, Renteln Kruse W *et al*. A randomized trial of effects of health risk appraisal combined with group sessions or home visits on preventive behaviors in older adults. The Journals of Gerontology A, Biological sciences and medical sciences; Series.
5	05094	Dunais B, Saccomano C, Mousnier A, Roure MC, Dellamonica P, Roger PM. Influenza vaccination: impact of an intervention campaign targeting hospital staff. Infection Control & Hospital Epidemiology. 2006; 27(5).
6	00316	Durand C, Flament E. Pertussis Vaccination for Parents: Proposal and Evaluation of Two Professional Practices in a Maternity Hospital. Arch Pediatr 2011; 18(4).
7	03231	Friedl A, Aegerter C, Saner E, Meier D, Beer JH. An intensive 5-year-long influenza vaccination campaign is effective among doctors but not nurses. Infection 2012; 40(1).
8	04219	Harbarth S, Siegrist CA, Schira JC, Wunderli W, Pittet D. Influenza immunization: improving compliance of healthcare workers. Infection Control & Hospital Epidemiology. 1998; 19(5).
9	01238	Humair JP, Buchs CR, Stalder H. Promoting Influenza Vaccination of Elderly Patients in Primary Care. Fam Pract 2002; 19(4).
10	03008	Leitmeyer K, Buchholz U, Kramer M *et al*. Influenza Vaccination in German Health Care Workers: Effects and Findings After Two Rounds of a Nationwide Awareness Campaign. Vaccine 2006; 24(47-48).
11	02771	Luthi JC, Mean F, Ammon C, Burnand B. Evaluation of a Population-Based Prevention Program Against Influenza Among Swiss Elderly People. Swiss Medical Weekly 2002; 132(41-42).
12	10262	Moretti Manuel, Grill Eva, Weitkunat Rolf *et al*. An individualized telephone intervention to increase the immunization rates of school beginners. [German]. [References]. Zeitschrift Fur Gesundheitspsychologie. Vol.11(2), 2003; 2003, pp. 39-48.
13	01279	Pallasch G, Salman R, Hartwig C. Improvement of Protection Given by Vaccination for Socially Underprivileged Groups on the Basis of "Key Persons Approach" - Results of an Intervention Based on Cultural and Language Aspects for Children of Immigrants in Altlander Viertel Provided by the Health Department of Stade. Gesundheitswesen 2005; 67(1).
14	00325	Parache C, Carcopino X, Gossot S *et al*. Bacillus Calmette-Guerin (Bcg) Vaccine Coverage in Newborns and Infants at Risk Before and After a Change in Bcg Policy. Arch Pediatr 2010; 17(4).
15	05265	Pasquarella A, Perria C, D'Amato M *et al*. [Management of vaccination practices in adults: the influenza vaccination campaign in Lazio region, Italy]. [Italian]. Ann Ig 2003; 15(6).
16	01280	Roggendorf H, Freynik P, Hofmann F. Improvement Strategy to Increase Vaccination Rates in Adolescents. Gesundheitswesen 2011; 73(8-9).

N	Id	Reference
17	00039	Rothan-Tondeur M, Filali-Zegzouti Y, Belmin J *et al*. Assessment of Healthcare Worker Influenza Vaccination Program in French Geriatric Wards: a Cluster-Randomized Controlled Trial. Aging Clinical and Experimental Research 2010; 22(5-6).
18	01941	Rothan-Tondeur M, Filali-Zegzouti Y, Golmard JL *et al*. Randomised Active Programs on Healthcareworkers' Flu Vaccination in Geriatric Health Care Settings in France: the Vesta Study. Journal of Nutrition Health & Aging 2011; 15(2).
19	04221	Roth-Kleiner M, Gnehm HE. [MMR, diphtheria-tetanus and polio vaccination of students in Aargau]. [German]. Praxis 1997; 86(49).
20	09514	Schmid K, Merkl K, Hiddemann-Koca K, Drexler H. Obligatory occupational health check increases vaccination rates among medical students. J Hosp Infect 70 (1) (pp 71-75), 2008. Date of Publication: September 2008.
21	10273	Tapiainen T, Bär G, Schaad UB, Heininger U. Influenza vaccination among healthcare workers in a university children's hospital. Infection Control & Hospital Epidemiology , 2005 Nov; 26 (11).
22	05539	Toscani L, Gauthey L, Robert C.-F. The information network of senior citizens in Geneva, Switzerland, and progress in flu vaccination coverage between 1991 and 2000. Vaccine 21 (5-6) (pp 393-398), 2003. Date of Publication: 17 Jan 2003.

Table 8. Included systematic reviews.

N	Id	Reference
1	04158	Austin SM, Balas EA, Mitchell JA, Ewigman BG. Effect of physician reminders on preventive care: meta-analysis of randomized clinical trials. Proceedings - the Annual Symposium on Computer Applications in Medical Care. :121-4, 1994; 1994.
2	00621	Batt K, Fox-Rushby JA, Castillo-Riquelme M. The Costs, Effects and Cost-Effectiveness of Strategies to Increase Coverage of Routine Immunizations in Low- and Middle-Income Countries: Systematic Review of the Grey Literature. Bull World Health Organ 2004; 82(9).
3	00192	Bordley WC, Chelminski A, Margolis PA, Kraus R, Szilagyi PG, Vann JJ. The Effect of Audit and Feedback on Immunization Delivery - a Systematic Review. Am J Prev Med 2000; 18(4).
4	02807	Glenton C, Scheel IB, Lewin S, Swingler GH. Can Lay Health Workers Increase the Uptake of Childhood Immunisation? Systematic Review and Typology. Tropical Medicine & International Health 2011; 16(9).
5	00264	Houle SKD, Mcalister FA, Jackevicius CA, Chuck AW, Tsuyuki RT. Does Performance-Based Remuneration for Individual Health Care Practitioners Affect Patient Care? A Systematic Review. Ann Intern Med 2012; 157(12).
6	03971	Jacobson Vann JC, Szilagyi P. Patient reminder and patient recall systems to improve immunization rates. [Review] [161 refs][Update of Cochrane Database Syst Rev. 2002;(4):CD003941; PMID: 12519624]. Cochrane Database of Systematic Reviews. 2005; (3).
7	04102	Kendrick D, Hewitt M, Dewey M *et al*. The effect of home visiting programmes on uptake of childhood immunization: a systematic review and meta-analysis. [Review] [28 refs]. J Public Health Med 2000; 22(1).
8	05908	Lau D, Hu J, Majumdar S.R., Storie D.A., Rees S.E., Johnson J.A. Interventions to increase influenza and pneumococcal vaccinations in community-dwelling adults: A systematic review and meta-analysis. Pharmacoepidemiology and Drug Safety. Conference: 27th International Conference on Pharmacoepidemiology and Therapeutic Risk Management Chicago, IL United States. Conference Start: 20110814 Conference End: 20110817. Conference Publication: (var.pagings). 20 (pp S361-S362), 2011. Date of Publication: August 2011.
9	03623	Lau F, Kuziemsky C, Price M, Gardner J. A review on systematic reviews of health information system studies. [Review]. J Am Med Inform Assoc 2010; 17(6).
10	00875	Lewin S, Munabi-Babigumira S, Glenton C *et al*. Lay Health Workers in Primary and Community Health Care for Maternal and Child Health and the Management of Infectious Diseases. Cochrane Database of Systematic Reviews 2010; (3).
11	00194	Ndiaye SM, Hopkins DP, Shefer AM *et al*. Interventions to Improve Influenza, Pneumococcal Polysaccharide, and Hepatitis B Vaccination Coverage Among High-Risk Adults - a Systematic Review. Am J Prev Med 2005; 28(5).
12	02176	Sarnoff R, Rundall T. Meta-Analysis of Effectiveness of Interventions to Increase Influenza Immunization Rates Among High-Risk Population Groups. Med Care Res Rev 1998; 55(4).
13	10284	Shea S, DuMouchel W, Bahamonde L. A meta-analysis of 16 randomized controlled trials to evaluate computer-based clinical reminder systems for preventive care in the ambulatory setting. J Am Med Inform Assoc , 1996 Nov-Dec; 3 (6).
14	10503	Shefer A, Briss P, Rodewald L *et al*. Improving immunization coverage rates: an evidence-based review of the literature. Epidemiol Rev , 1999; 21 (1).

N	Id	Reference
15	00272	Stone EG, Morton SC, Hulscher ME *et al*. Interventions That Increase Use of Adult Immunization and Cancer Screening Services: a Meta-Analysis. Ann Intern Med 2002; 136(9).
16	03635	Thomas RE, Russell M, Lorenzetti D. Interventions to increase influenza vaccination rates of those 60 years and older in the community. [Review] [428 refs]. Cochrane Database of Systematic Reviews. 2010; (9).
17	03379	Williams N, Woodward H, Majeed A, Saxena S. Primary care strategies to improve childhood immunisation uptake in developed countries: systematic review. JRSM Short Reports. 2011; 2(10).
18	10504	Willis BC, Ndiaye SM, Hopkins DP, Shefer A. Improving influenza, pneumococcal polysaccharide, and hepatitis B vaccination coverage among adults aged less than 65 years at high risk: a report on recommendations of the Task Force on Community Preventive Services. MMWR: Morbidity & Mortality Weekly Report , 2005 Apr 1; 54 (RR-5).

Annex 5. Quantitative findings

Table 9. Quantitative findings from primary research studies.

	Idn	Author	Year	Type of intervention	Detail	Measure	Estimate	Low	High	Type
1	09635	Baudier	2007	Information (users)	Week of vaccination with community healthcare professionals; media campaign, visits to local physicians, training, posters, booklets, exhibition.	**Median of absolute % difference over years**	**7.85**	**-4.00**	**39.00**	**Min / Max**
2	01804	Birchmeier	2002	Health information (system)	Medical student informing (prevention and complications) and proposing an influenza vaccination before patient met the doctor.	**Relative % change**	**1.58**			
3	03237	Boillat Blanco	2011	Way of delivery	Nurse vaccination program.	**Rate ratio**	**2.01**			
4	02047	Dapp	2011	Education (users)	HRA and group session or home visit.	**Median OR**	**2.25**	**1.85**	**2.85**	**95%CI**
5	05094	Dunais	2006	[Combination]	Information sessions with vaccination offered on the spot.	**Relative % change**	**8.71**			
6	00316	Durand	2011	Way of delivery	I1: information and vaccine prescription for both parents at discharge from the maternity. I2: vaccination proposed to both parents during hospitalization in maternity.	**Median Relative % change**	**6.87**	**6.63**	**7.11**	**Min / Max**
7	03231	Friedl	2012	Way of delivery	Free vaccination at workplace; information materials; campaign.	**Relative % change years 5 to 7 versus 1 to 3**	**1.10**			
8	04219	Harbarth	1998	Education (users)	Educational conferences; nurse taking vaccines to wards, clinics, and conferences; educational measures (e.g. letter to HCWs with pay check) attended by HCW.	**Median Relative % change**	**2.70**	**2.85**	**2.56**	**Min / Max**
9	01238	Humair	2002	[Combination]	Leaflets, posters; walk-in vaccination clinic; training workshop for MDs; record reminders and peer comparison on vaccination performance; reminder stickers for medical records.	**Relative benefit**	**2.60**			
10	03008	Leitmeyer	2006	Information (users)	Posters, hand-outs; text suggestions for employee mailings; list of suggested activities to increase influenza vaccination among HCW.	**Relative % change**	**1.27**	**0.88**	**1.48**	**Min / Max**
11	02771	Luthi	2002	Health information (system)	information-meetings (e.g. leaflets, videos, local TV) about vaccination among associations for the elderly and for staff of socio-medical institutions.	**Median Relative % change**	**1.08**	**1.01**	**1.16**	**Min / Max**
12	10262	Moretti	2003	Information (users)	Letter and then a phone call to get vaccination status. If MMR not complete, persuasion talk.	**Median rate ratios**	**0.83**			

	Idn	Author	Year	Type of intervention	Detail	Measure	Estimate	Low	High	Type
13	01279	Pallasch	2005	[Combination]	Education by peer key persons as educators; local vaccination stations.	**Relative % change years 4 and 5 versus 1 and 2**	**1.37**			
14	00325	Parache	2010	Organisation / governance	Vaccination programme in maternity.	**Relative change (before and after maternity)**	**0.65**			
15	05265	Pasquarella	2003	[Combination]	Coordination, providers' incentives, vaccination in general practices, health information.	**Relative annual change**	**1.13**			
16	01280	Roggendorf	2011	Health information (system)	Letter to parents about the need of vaccination.	**Median Relative % change**	**1.52**	**1.37**	**1.67**	**Min / Max**
17	00039	Rothan-Tondeur	2010	Education (users)	Information to develop a sense of altruism in HCWs.	**Rate ratio**	**0.95**			
18	01941	Rothan-Tondeur	2011	Health information (system)	Involve HCWs in the creation of “safety zones”; reward wards showing increased vaccination coverage; slide show, posters, two booklets/leaflets, and rubber bracelets.	**Rate ratio**	**1.10**			
19	04221	Roth-Kleiner	1997	Way of delivery	Vaccination campaign.	**Median Relative % change**	**5.96**	**1.89**	**13.07**	**Min / Max**
20	09514	Schmid	2008	Way of delivery	Health check as preclinical students.	**Median rate ratios**	**1.16**	**-4.07**	**6.62**	**Min / Max**
21	10273	Tapiainen	2005	[Combination]	Letter addressing misconceptions found in a preceding survey; educational conversation with head nurses ; more "walk-in" vaccination clinics; vaccination in the wards.	**Median Relative % change**	**1.08**	**1.00**	**1.49**	**Min / Max**
22	05539	Toscani	2003	Information (users)	TV spots, press conferences, information to health professionals, Internet site, leaflets, posters to risk groups.	**Relative % change**	**2.04**			

Table 10. Quantitative findings from systematic reviews.

Idn	Author	Year	Type of intervention	Detail	Measure	Estimate	Low	High	Type
10503	Shefer-1	1999	Education (users)	Education combined with reminders, access, costs, WIC, records, incentives, feed-back, home visits.	**Coverage change (median)**	**16.00**	**-4.00**	**29.00**	**range**
10503	Shefer-2	1999	Information (users)	Reminders, recall.	**Coverage change (median)**	**12.00**	**-8.00**	**47.00**	**range**
10503	Shefer-3	1999	Other (users)	Incentives.	**Coverage change (median)**	**8.00**	**5.00**	**15.00**	**range**
10503	Shefer-4	1999	Financial resources (users)	Reducing the costs of vaccines to families.	**Coverage change (median)**	**15.00**	**-8.00**	**47.00**	**range**
10503	Shefer-5	1999	[Combination]	Women, infants, children	**Coverage change (median)**	**9.00**	**4.00**	**34.00**	**range**
10503	Shefer-6	1999	Way of delivery	Home visits.	**Coverage change (median)**	**10.00**	**-1.00**	**49.00**	**range**
10503	Shefer-7	1999	Way of delivery	Access interventions.	**Coverage change (median)**	**10.00**	**-8.00**	**35.00**	**range**
10503	Shefer-8	1999	Organisation / governance	Entry requirements.	**Coverage change (median)**	**15.00**	**5.00**	**35.00**	**range**
10503	Shefer-9	1999	Health information (system)	Reminders, recall.	**Coverage change (median)**	**17.00**	**1.00**	**67.00**	**range**
10503	Shefer-10	1999	Organisation / governance	Assessment and feed-back.	**Coverage change (median)**	**16.00**	**1.00**	**43.00**	**range**
10503	Shefer-11	1999	Health information (system)	Standing orders.	**Coverage change (median)**	**51.00**	**30.00**	**81.00**	**range**
00192	Bordley	2000	Human resources	Audit and feed-back.	**Coverage change**		**-4.00**	**49.00**	**range**
00194	Ndiaye-1	2005	Health information (system)	Reminders.	**Coverage change (median)**	**17.90**	**-1.00**	**72.00**	**range**
00194	Ndiaye-4	2005	[Combination]	Client demand, provider-based intervention.	**Coverage change (median)**	**3.70**	**-2.00**	**28.90**	**range**
00194	Ndiaye-5	2005	[Combination]	Client demand, access.	**Coverage change (median)**	**14.00**	**3.10**	**46.00**	**range**
00194	Ndiaye-6	2005	[Combination]	Provider-based, access.	**Coverage change (median)**	**27.80**	**-0.50**	**31.00**	**range**
00194	Ndiaye-7	2005	[Combination]	Provider-based, access, demand.	**Coverage change (median)**	**22.80**	**-5.90**	**67.00**	**range**
00264	Houle	2012	Financial resources (system)	Pay for performance.	**Not specified**		**0.03**	**<0.05**	**range**
00272	Stone-1	2002	Organisation / governance	Organisational change.	**Use of services (relative change)**	**16.00**	**11.20**	**22.80**	**95CI**
00272	Stone-2	2002	Health information (system)	Reminders.	**Use of services (relative change)**	**3.80**	**3.31**	**4.37**	**95CI**
00272	Stone-3	2002	Financial resources (users)	Financial incentives.	**Use of services (relative change)**	**3.42**	**2.89**	**4.06**	**95CI**
00272	Stone-4	2002	Human resources	Education.	**Use of services (relative change)**	**3.21**	**2.24**	**4.61**	**95CI**

Idn	Author	Year	Type of intervention	Detail	Measure	Estimate	Low	High	Type
00272	Stone-5	2002	Information (users)	Reminders.	**Use of services (relative change)**	**2.52**	**2.24**	**2.82**	**95CI**
00272	Stone-6	2002	Education (users)	Education.	**Use of services (relative change)**	**1.29**	**1.14**	**1.45**	**95CI**
00272	Stone-7	2002	Financial resources (system)	Incentives.	**Use of services (relative change)**	**1.26**	**0.83**	**1.90**	**95CI**
00272	Stone-8	2002	Health information (system)	Feed-back.	**Use of services (relative change)**	**1.23**	**0.96**	**1.58**	**95CI**
00621	Batt	2004	[Combination]	Diverse	**Increase in full coverage (%)**	**20.00**	**-8.00**	**55.00**	**range**
00875	Lewin	2010	Human resources	Lay Health Workers.	**Immunisation schedule up to date**	**1.21**	**1.07**	**1.37**	**95CI**
02176	Sarnoff-1	1998	[Combination]	Patient focused	**Influenza coverage rates (relative change)**	**1.85**	**1.25**	**2.75**	**95CI**
02176	Sarnoff-2	1999	[Combination]	Provider focused	**Influenza coverage rates (relative change)**	**2.06**	**1.70**	**2.48**	**95CI**
02176	Sarnoff-3	2000	[Combination]	Mixed	**Influenza coverage rates (relative change)**	**2.50**	**1.75**	**3.58**	**95CI**
02807	Glenton	2011	Human resources	Lay Health Workers.	**Immunisation schedule up to date**	**1.19**	**1.09**	**1.30**	**95CI**
03379	Williams-1	2011	Information (users)	Reminders and recall.	**Immunisation rates, median change**	**11.00**	**-11.00**	**24.00**	**range**
03379	Williams-2	2011	Health information (system)	Reminders and recall.	**Immunisation rates, median change**	**10.00**	**-2.00**	**33.00**	**range**
03379	Williams-3	2011	Human resources	Provider education.	**Immunisation rates, median change**	**8.00**	**1.00**	**25.00**	**range**
03379	Williams-4	2011	Human resources	Feed-back.	**Immunisation rates, median change**	**19.00**	**12.00**	**19.00**	**range**
03623	Lau	2010	Health information (system)	Diverse	**Immunisation rates, median change**	**15.00**	**-4.00**	**47.00**	**range**
03635	Thomas-1	2010	Information (users)	Reminder and recall (not tailored).	**Studies with positive effects**	**84.60**			
03635	Thomas-2	2010	Information (users)	Reminder and recall (tailored).	**Relative change in coverage**	**1.21**	**0.99**	**1.48**	**95CI**
03635	Thomas-3	2010	Education (users)	Education.	**Relative change in coverage**	**1.53**	**1.33**	**1.76**	**95CI**
03635	Thomas-4	2010	Way of delivery	Home visits.	**Relative change in coverage**	**3.29**	**1.91**	**5.66**	**95CI**
03635	Thomas-5	2010	Financial resources (users)	Free vs. Invitation and payment.	**Relative change in coverage**	**1.30**	**1.05**	**1.61**	**95CI**
03635	Thomas-6	2010	Financial resources (users)	Free vs. no intervention.	**Relative change in coverage**	**2.36**	**1.98**	**2.82**	**95CI**
03635	Thomas-7	2010	Health information (system)	Reminder to provider.	**Relative change in coverage**	**5.43**	**2.85**	**10.35**	**95CI**

Idn	Author	Year	Type of intervention	Detail	Measure	Estimate	Low	High	Type
03635	Thomas-8	2010	Human resources	Encouragement.	**Relative change in coverage**	**1.28**	**0.73**	**2.25**	**95CI**
03635	Thomas-9	2010	Financial resources (system)	Payment to physicians.	**Relative change in coverage**	**5.51**	**0.56**	**53.78**	**95CI**
03635	Thomas-10	2010	Financial resources (system)	Payment to physicians.	**Relative change in coverage**	**2.22**	**1.77**	**2.77**	**95CI**
03971	Jacobson-1	2005	Information (users)	Postcard reminder.	**Relative change in coverage**	**1.44**	**1.09**	**1.89**	**95CI**
03971	Jacobson-2	2005	Information (users)	Letter reminder.	**Relative change in coverage**	**1.79**	**1.50**	**2.15**	**95CI**
03971	Jacobson-3	2005	Information (users)	Phone reminder.	**Relative change in coverage**	**1.92**	**1.20**	**3.07**	**95CI**
03971	Jacobson-4	2005	Information (users)	Autodialer reminder.	**Relative change in coverage**	**1.29**	**1.09**	**1.53**	**95CI**
03971	Jacobson-5	2005	Information (users)	Card and phone reminder.	**Relative change in coverage**	**1.45**	**1.11**	**1.89**	**95CI**
03971	Jacobson-6	2005	[Combination]	Patient and provider reminder.	**Relative change in coverage**	**3.65**	**1.54**	**8.67**	**95CI**
03971	Jacobson-7	2005	Information (users)	Patient reminder.	**Relative change in coverage**	**1.57**	**1.41**	**1.75**	**95CI**
03971	Jacobson-8	2005	Information (users)	Tracking and outreach.	**Relative change in coverage**	**1.37**	**0.98**	**1.92**	**95CI**
04102	Kendrick	2000	Way of delivery	Home visiting.	**Relative change in coverage**	**1.17**	**0.33**	**4.17**	**95CI**
04158	Austin	1994	Health information (system)	Physician reminders.	**Relative change in coverage**	**2.82**	**2.66**	**2.98**	**95CI**
05908	Lau-1	2011	[Combination]	Diverse (on influenza)	**Relative change in coverage**	**1.46**	**1.35**	**1.57**	**95CI**
05908	Lau-2	2011	[Combination]	Diverse (on pneumococcal)	**Relative change in coverage**	**2.01**	**1.72**	**2.36**	**95CI**
10284	Shea-1	1996	Health information (system)	Computer reminder.	**Relative change (no further defined)**	**3.09**	**2.39**	**4.00**	**95CI**
10284	Shea-2	1996	Health information (system)	Manual reminder.	**Relative change (no further defined)**	**2.46**	**1.86**	**3.25**	**95CI**
10284	Shea-3	1996	Health information (system)	Computer and manual reminder.	**Relative change (no further defined)**	**3.06**	**2.25**	**4.16**	**95CI**
10504	Willis-1	2005	[Combination]	Access, provider, user.	**Median change**	**22.80**	**-5.90**	**67.00**	**range**
10504	Willis-2	2005	[Combination]	Access and user.	**Median change**	**14.00**	**3.10**	**46.00**	**range**