Evaluation of the effectiveness of immunization delivery methods

Authors' objectives
To review the effectiveness of immunisation delivery methods for influenza; pneumonia; hepatitis B; measles, mumps, and rubella (MMR); diphtheria, pertussis, tetanus and polio (DPTP).

Searching
MEDLINE and SciSearch were searched from 1979 to September 1992; the search strategy for the MEDLINE search is included in the authors' text. The bibliographies of the retrieved articles were examined for additional relevant studies. Unpublished documentation was identified by contacting experts and expert institutions.

Study selection
Study designs of evaluations included in the review


Hepatitis B. Client-orientated studies: 1 RCT.

MMMR. Client-orientated studies: 2 RCT. System-orientated studies: 2 cohort and 4 observational community studies.

DPTP. System-orientated studies: 1 cohort and 3 observational community studies. Client-orientated studies: 1 clinical trial.

Specific interventions included in the review
Interventions were categorised as: orientated towards the client, e.g. mailed reminders to patients); orientated to the provider, e.g. chart reminders to physicians; or system related, e.g. legislation. Where interventions were orientated to more than one group they were classified as mixed.

Participants included in the review
Influenza: in 86% (31 out of 36) of the evaluated studies participants were over the age of 65 and attending out-patient clinics, whereas in the remaining studies the patients were of a similar age but resident in hospital.

Pneumonia: the target population was primarily clinic patients (6 studies) and hospitalised high-risk patients (3 studies). One study evaluated patients in long-term care and another study evaluated all eligible individuals in the population.

Hepatitis B: the single study evaluated hospital physicians and residents.

MMR: 4 studies evaluated children under 18 years of age, and the other 2 studies were conducted on the general population.

DPTP: all studies included pre-school children.

Outcomes assessed in the review
All studies assessed immunisation coverage of the target population. Reduction in disease incidence was an important measure for MMR.
How were decisions on the relevance of primary studies made?
The following selection criteria were used to identify potential studies for review:

1. Target populations were restricted to human populations from developed countries.
2. Any immunisation delivery method.
3. No restriction was placed on the type of outcome measured in the community.
4. Only studies that compared one or more interventions with a control group were eligible.
5. Only studies published in English or French were included.

Assessment of study quality
The methodological criteria developed by the CHPG working group (referenced in the authors' text) was used to assess each individual study's internal validity. Studies were rated as strong, moderate or weak. Each study was appraised independently by two reviewers, and any disagreements in assessment were resolved by a second appraisal and/or consensus.

Data extraction
The authors do not state how the data were extracted for the review, or how many of the authors performed the data extraction.

Methods of synthesis
How were the studies combined?
The intervention effect was calculated as a difference in outcome rate (i.e. coverage and disease incidence) between the intervention group and the comparison or control group. More than one measure of effect could be reported by a study because several studies evaluated more than one intervention type (i.e. letter reminder and telephone call by nurse).

Pooled effects were calculated using a method that adjusted for the study sample size, and confidence intervals (CIs) were calculated using a random-effects model (in both cases the exact test or model is not given). Interventions orientated to the same population over 2 or more years were excluded from the pooled data analysis.

How were differences between studies investigated?
Where possible, studies were grouped into different subgroups in order to examine and compare differences in the pooled effect. Criteria for grouping studies included: type of intervention, study design, internal validity ratings, and baseline population coverage level.

Results of the review
Fifty-four articles in total: 24 influenza, 11 pneumonia, 1 hepatitis B, 13 MMR and 5 DPTP.

ADULT IMMUNISATIONS

1. Influenza.

Type of intervention:

Client-orientated: pooled effect 12.2% (95% CI: 10.6, 13.7). Provider-orientated: pooled effect 18.1% (95% CI: 16.5, 19.8). System-orientated: pooled effect 39.4% (95% CI: 29.7, 49.0). Mixed: pooled effect 16.8% (95% CI: 14.8, 18.8). Total: pooled effect 18.6% (95% CI: 17.7, 19.5).

Target population coverage:
Hospitalised populations: pooled effect 61.7% (95% CI: 45.2, 78.2). Out-patient populations: pooled effect 15.9% (95% CI: 15.0, 16.9).

Study design effect on coverage:
RCTs: pooled effect 12.9% (95% CI: 10.2, 15.7). Other designs: pooled effect 27.1% (95% CI: 25.5, 28.7).

Effect of internal study validity on coverage:
Strong or moderate: pooled effect 17.9% (95% CI: 17.9, 21.1). Weak: pooled effect 20.0% (95% CI: 18.4, 21.6).

Baseline population coverage:
Baseline less than 20%: pooled effect 20.5% (95% CI: 17.9, 21.1). Baseline 20 to 50%: pooled effect 19.3% (95% CI: 17.5, 21.2). Baseline greater than 50%: pooled effect 14.8% (95% CI: 12.3, 17.3).

2. Pneumococcal.

Type of intervention:
Client-orientated: pooled effect 75.0% (95% CI: 64.4, 85.6). Provider-orientated: pooled effect 7.5% (95% CI: 3.4, 11.6). System-orientated: pooled effect 45.5% (95% CI: 37.2, 53.7). Mixed: pooled effect 5.5% (95% CI: -1.9, 12.9). Total: pooled effect 29.7% (95% CI: 24.9, 34.5).

Target population coverage:
Hospitalised populations: pooled effect 53.4% (95% CI: 34.8, 72.1). Out-patient populations: pooled effect 2.7% (95% CI: -2.2, 7.6). General population: pooled effect 18.7% (95% CI: -1.6, 39.9).

Study design effect on coverage:
Clinical trials: pooled effect 28.7% (95% CI: 24.1, 33.3). RCTs: pooled effect 8.6% (95% CI: 4.5, 12.6). Trials: pooled effect 7.5% (95% CI: 70.0, 83.4). Observational study: pooled effect 28.9% (95% CI: 20.6, 37.1). Cohort: pooled effect 45.5% (95% CI: 10.0, 90.7). Community study: pooled effect 5.5% (95% CI: 12.3, 17.3).

Effect of internal study validity on coverage:
Strong: pooled effect 34.6% (95% CI: -0.6, 69.8). Moderate: pooled effect 78.0% (95% CI: 72.3, 83.8). Weak: pooled effect 18.5% (95% CI: 17.7, 19.3).

Baseline population coverage:
Insufficient data: in only 3 comparisons was the baseline rate above 20% (excluding non-independent intervention effects).

3. Hepatitis B

Only one study was included. This was an RCT judged to be of weak internal validity.

Increased coverage of target population:
Mailing only: 1.9% (95% CI: -4.1, 7.9). Mailing plus decision analysis: 6.3% (95% CI: 1.0, 11.6).

CHILDHOOD IMMUNISATIONS

4. MMR.
Type of intervention:

Pooling of studies was not deemed appropriate because of differences in, e.g. intervention and target population.

Client-orientated: of the 2 included studies, 1 increased coverage by 62% (baseline 3.1%) and the other increased coverage by 5% (baseline 42%).

System-orientated: studies were concerned with legislation, public versus private type of services and technical resources. Legislation was found to have the biggest effect.

Target population coverage:

In children of school age or older, all studies showed effects of 44% or higher. In pre-school children the effect of interventions ranged from -43.5 to 25%.

Effect of internal study validity on coverage:

Only 3 of 8 studies were rated as strong or moderate. A letter reminder had little effect (5%); legislation had a large effect (44%); and a change in the immunisation schedule resulted in a decrease in coverage (-42%).

Baseline population coverage:

Most studies had a baseline coverage rate between 30 and 70%, with the exception of one study that had a baseline coverage rate of 3.1%.

5. DPT.

The calculation of pooled effects was inappropriate because of the small number of studies.

Only individual effects of the interventions evaluated in each study are presented. Feedback of immunisation practice resulted in large effects (56.1%, 95% CI: 42.2, 70.0) as did postcard reminders (33.9%, 95% CI: 19.9, 48.0). Changing the timing of MMR vaccination from 12 to 15 months resulted in a decrease in coverage levels of the DPT booster at 18 months.

Cost information

Economic evaluations were only referred to for measles, mumps and rubella. There were two relevant studies. The first of these studies showed that if only 10% of the target population was susceptible to measles and rubella, and if less than 75% of the previous immunisation records were available, the least expensive strategy would be to vaccinate all individuals regardless of their previous immunisation history. The second study showed that the cost per vaccination per child aged up to 4 years old is $30.00 (in CN$ for 1990) less in a public health run programme than in a private run system.

Authors' conclusions

1. Influenza.

Interventions designed at improving immunisation coverage have their largest effect when aimed at hospital populations. Standing orders for vaccine in hospitals and clinics also has a positive effect on immunisation coverage levels. Evidence from several studies of community-dwelling clinic-registered eligible individuals suggests that a high response is achieved when personalised mailed reminders or health care practitioner-initiated telephone calls are used. The analysis of baseline coverage may suggest the presence of a ceiling effect, since studies having baselines of 50% or higher have significantly less improvement in coverage levels than others.

2. Pneumococcal.
A client- or system-orientated intervention targeted at hospitalised high-risk patients can ensure high vaccination rates. Only one community-based study was available which suggested that increased immunisation rates could be effected when the health department both promotes and offers the vaccine. There is a lack of relevant studies with regard to this vaccine, especially in a community setting, and further research should be promoted. Feasibility, effectiveness and cost-effectiveness analysis should also be addressed in the future.

3. Hepatitis B.

Only one study was available and its applicability to the general population is limited. The lack of relevant studies suggests that further research in this field should be an imperative.

4. Primary immunisations (MMR and DPTP).

Greater coverage rates were found with system-orientated interventions than in client-orientated interventions. Computerisation, being served by a Health Maintenance organisation, and providing feedback on practice were all shown to result in increases in coverage. Changing the schedule of DPT vaccine administration from 12 to 15 months resulted in a decrease in coverage.

CRD commentary
A valuable review in a field where little literature is available. However, the pooling of studies evaluating very different outcome measures could be questioned, especially since the authors avoid analysis for heterogeneity; they do avoid pooling for MMR and DDPT when there were obviously great differences between the component studies. The review encompasses a wide spectrum of vaccines and would be useful for those wishing to identify general issues relating to immunisation delivery. It should be noted that some of the strategies described in the text will not be relevant to UK practice under present policy, i.e. standing orders for vaccine.

Implications of the review for practice and research
Sustainability of interventions needs to be investigated. More attention should be focused on ensuring immunisation is adequately covered in medical school curricula or in continuing medical education courses.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.