Cost-effectiveness of three different vaccination strategies against measles in Zambian children

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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Three vaccination strategies against measles were examined. In the first (strategy 1), one dose of measles vaccine was delivered through the routine health care system at 9 months of age. In the second (strategy 2), one dose of measles vaccine was delivered through the routine health care system at 9 months of age and there was a second opportunity for immunisation through supplemental immunisation activities (SIAs). In the third (strategy 3), two doses of measles vaccine were delivered through the routine health care system at 9 and 18 months of age. With the last strategy, only children who had received a dose at 9 months received the second dose at 18 months.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a hypothetical cohort of children receiving the measles vaccine.

Setting
The setting was primary care. The economic study was carried out in Zambia.

Dates to which data relate
The effectiveness and resource use data were derived from studies published between 1962 and 2001. The price year was 2000.

Source of effectiveness data
The effectiveness evidence was derived from a synthesis of completed studies and some assumptions.

Modelling
A decision tree model was constructed to determine the costs and benefits of the three vaccination strategies in the population of eligible Zambian children. The model considered not only the efficacy of vaccination, but also the coverage rate and the adverse events following vaccination. The structure of the tree was reported. The analytic horizon of the model was 15 years.

Outcomes assessed in the review
The outcomes assessed were:
the size of the annual birth cohort,

vaccine coverage with the first and second doses,

vaccine efficacy with the first and second doses,

the wastage multiplier in routine health care services and SIAs,

the rate of adverse events in susceptible children,

the measles attack rates among susceptible children,

the proportion of measles case-patient seeking medical care, and

the hospitalisation rate.

Study designs and other criteria for inclusion in the review

It was unclear whether a systematic review of the literature had been undertaken. The design of the primary studies was not reported.

Sources searched to identify primary studies

Not stated.

Criteria used to ensure the validity of primary studies

Not stated.

Methods used to judge relevance and validity, and for extracting data

Not stated.

Number of primary studies included

Twelve studies provided the evidence.

Methods of combining primary studies

It appears that the primary studies have been combined using narrative methods.

Investigation of differences between primary studies

Not stated.

Results of the review

The annual birth cohort included 400,000 children.

The vaccine coverage was 80% with both the first and the second doses.

The vaccine efficacy was 85% with the first dose and 95% with the second dose.

The wastage multiplier was 3.42 in routine health care services and 1.1 in SIAs.

The rate of adverse events in susceptible children was 5%.
The measles attack rate among susceptible children was 21 per 1,000 in children aged 5 years or younger, and 3.5 per 1,000 in children older than 5 years.

The proportion of measles case-patient seeking medical care was 75%.

The hospitalisation rate was 80%.

**Methods used to derive estimates of effectiveness**

The authors made some assumptions that were used in the decision model.

**Estimates of effectiveness and key assumptions**

The number of visits per child with adverse events was 1. The overall measles incidence rate was 6.7 per 1,000 in children aged 5 years or younger, and 1.1 per 1,000 in children older than 5 years. The reporting rate was 40%. The number of visits per ambulatory patient was 1. The duration of hospitalisation was 4 days. The case-fatality ratio was 5%.

**Measure of benefits used in the economic analysis**

The summary benefit measures used in the economic analysis were the number of measles cases and deaths prevented. Both were derived from the decision model.

**Direct costs**

Discounting was relevant since the time horizon of the model was 15 years. An annual discount rate of 3% was applied. The unit costs were presented separately from the quantities of resources used. The health services included in the economic evaluation were vaccination and treatment of illness. Vaccination covered doses, equipment, personnel, transportation and administrative services. Treatment included hospitalisations, ambulatory visits and drugs. The cost/resource boundary of the health care system was used. Resource use was estimated using data derived from the literature and authors’ assumptions. The costs were estimated from the Department of Health of Zambia. The price year was 2000.

**Statistical analysis of costs**

The costs were treated deterministically.

**Indirect Costs**

The indirect costs were not considered in the economic analysis.

**Currency**

US dollars ($). The exchange rate in 2000 was $1.00 = 3,200 Zambian Kwacha.

**Sensitivity analysis**

One-way sensitivity analyses were carried out to test the robustness of the cost-effectiveness ratios to variations in the model inputs. The variables investigated were vaccine coverage, wastage, vaccination costs, disease incidence, the percentage of children reached with the second opportunity, the treatment costs for ambulatory visits and hospitalisation. No justification was provided for the choice of the ranges used in the sensitivity analysis.

**Estimated benefits used in the economic analysis**

There were 38,476 measles cases with strategy 1, 9,234 with strategy 2, and 24,769 with strategy 3. There were 1,924
Cost results
The disease costs were $541,478 with strategy 1, $129,958 with strategy 2, and $348,576 with strategy 3.

The vaccination costs were $271,360 with strategy 1, $455,040 with strategy 2, and $522,320 with strategy 3.

The total costs were $812,838 with strategy 1, $584,998 with strategy 2, and $870,896 with strategy 3.

Synthesis of costs and benefits
An incremental analysis was carried out to combine the costs and benefits of the alternative vaccination strategies. However, the incremental cost-effectiveness ratios were not calculated because strategy 2 dominated the other strategies (being both more effective and less costly). In addition, it was the only strategy that resulted in savings per case and per death prevented in comparison with the one-dose strategy.

The sensitivity analysis showed that the base-case results were quite robust to variations in the model inputs. Using strategy 3, vaccination coverage for each dose would have to increase from 80 to 99.5% to equal the benefits (i.e. disease prevented) with strategy 2. Increases in wastage factor in routine health services led to much greater and more rapid decreases in savings per averted cases for strategy 3 than for strategy 2.

Authors’ conclusions
Vaccination schedules that offer two opportunities for measles vaccination improved measles control in Zambia in comparison with a one-dose strategy. In particular, the schedule that offered two doses through supplemental immunisation activities (SIAs) was the most cost-effective strategy, and resulted in cost-savings and the prevention of cases or deaths. The analysis showed that vaccination coverage was a key factor.

CRD COMMENTARY - Selection of comparators
The selection of the comparators was appropriate. One-dose vaccination represented the routine schedule, while the two-dose vaccination strategies were alternatives recommended in WHO guidelines. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness evidence came mainly from published studies, but it was not stated whether a systematic review of the literature had been undertaken. In fact, the primary studies appear to have been identified selectively. No information on the design and characteristics of the primary sources was provided. Therefore, it is not possible to assess the validity of the primary studies. Narrative methods were used to combine the estimates. Some model inputs were also based on authors' opinions, which introduced some uncertainty in the model. Extensive sensitivity analyses were performed on the key inputs.

Validity of estimate of measure of benefit
The summary benefit measures were specific to the interventions considered in the study. As such, they appear hardly comparable with the benefits of other health care interventions. They were derived from a decision model that simulated the natural history of disease.

Validity of estimate of costs
The authors stated explicitly which perspective was adopted in the study. All the relevant categories of costs appear to have been included in the analysis. The authors noted that some categories of costs, such as those related to routine health services (i.e. personnel, building, surveillance, training) were not included. Similarly, intangible costs were not
considered, and the inclusion of such costs would have further favoured strategy 2. The authors provided all the details of the cost analysis, such as the quantities of resources used and the unit costs, which enables the study to be replicated in other contexts. Likewise, the price year was provided, which aids reflation exercises in other settings. The source of the data was provided. The costs were treated deterministically in the base-case, but some cost estimates were varied in the sensitivity analysis.

Other issues
The authors made some comparisons of their findings with those from other studies. They did not explicitly address the issue of the generalisability of the study results to other settings, although the sensitivity analyses would have improved the external validity of the analysis. The authors noted some limitations to the validity of their study. For example, some categories of costs were excluded and some assumptions were used as a source of data.

Implications of the study
The study results suggested that the inclusion of a second opportunity through SIAs was the best strategy for the implementation of future two-dose measles vaccination policies in Zambia. Future studies should be carried out, not only to gather more robust cost data of vaccination strategies but also to examine the cost-effectiveness of targeting different age groups.

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None stated.

Bibliographic details

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Other publications of related interest


Indexing Status
Subject indexing assigned by NLM

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