Economic analysis of measles eradication

Introduction

The Region of the Americas has interrupted indigenous transmission of wild measles virus since November 2002 but continues to get importations of measles that result in costly outbreak response efforts. In addition to the Americas, three WHO regions (European, Eastern Mediterranean, and Western Pacific) have established measles elimination goals. The Africa region has a pre-elimination goal of 98% mortality reduction by 2102, and the SE Asia region has a measles mortality reduction goal. The overriding global goal for measles control is a 90% reduction in measles deaths by 2010 compared with 2000 levels.

Measles is thought to have the biological characteristics and an effective intervention (measles vaccine) that would allow it to be eradicated. However, debate continues as to whether the world should target measles for eradication given its highly infectious nature, the relatively weak state of some national immunization programmes and surveillance systems, opportunity costs, the lack of clarity as to optimal post-eradication vaccination strategies, and the fact that polio eradication is not yet completed.

In order to assess the appropriateness of measles eradication, programmatic, biological and economic considerations must be taken into account. This analysis is concerned with the economic aspects of measles eradication. Other aspects of the feasibility and appropriateness of measles eradication will be addressed in separate areas of work as part of the WHO feasibility of measles eradication project. These include the biological feasibility, the programmatic feasibility, the impact on health systems and expected impact on vaccine demand and supply.

Proposals will be reviewed by the WHO Quantitative Immunization and Vaccine related Research Advisory Committee (QUIVER) who will select the most qualified proposal. Throughout this analysis, the models and methodology will be reviewed by QUIVER and its working group on measles. In addition, the successful applicants will work closely with other groups working on the WHO project on assessing the feasibility of measles eradication activities on health systems.

Objectives

The objectives of this work are to address the economic considerations needed to assess the feasibility and appropriateness of measles eradication. More specifically:

• to compare the cost and cost-effectiveness (CE) of global measles eradication to the cost and CE of achieving an intermediate goal (e.g. 98% mortality
reduction and to achieving and sustaining the current global goal of 90% reduction in measles mortality compared to 2000 levels.

• to carry out the above analysis in six countries using primary data obtained from countries representative of the 6 WHO regions (primary data collection form these six countries will be carried out by another group)

**Methods**

For the purpose of this economic analysis, measles eradication is defined as the interruption of measles transmission worldwide as a result of deliberate efforts. Eradication represents the sum of successful elimination efforts in all countries. Once measles eradication has been achieved, a number of vaccination strategy options are possible where the number of vaccine doses per child can vary from zero to two. Mortality reduction is taken as 90% (or 98%) reduction in measles deaths compared to the estimated 2000 levels. Once mortality reduction is achieved, it is assumed that the same immunization strategy would continue to sustain the mortality reduction goal.

Two analytical horizons (i.e. the period over which the costs and benefits of the health outcomes that occur as result of the interventions considered) will need to be considered to address both the shorter term and longer term costs and benefits (20 and 50 year time horizons).

The following scenarios should be used in the analysis:

1. For eradication objective, the starting point is year 2009, assume that global eradication is achieved at 2025 and carry out an economic analysis up to 2030 and 2060. Estimate the economic consequence of the following strategies. From start to eradication, analyse using a strategy which achieves high routine measles vaccination coverage (at least 95%) plus high coverage either with routine delivery or with second opportunity campaigns. For the campaigns, several target age groups would be modelled: a) 1-14 years for catch-up campaigns and 1-4 years old for follow up campaigns assuming the latter would take place every 4 years; b) older age group catch up campaigns to take into account factors such as the "shift" of measles susceptibility towards older adolescents and adults and the use of MR in the campaigns to control rubella. Assuming eradication by 2025, compare a number of alternative post eradication strategies including:
   i. Use only TWO routine doses and no campaigns
   ii. Use only ONE routine dose and no campaigns
   iii. Stop all measles vaccination
   iv. Use new technologies (e.g. aerosol vaccines used in i. and ii. above)

2. For mortality reduction (compared to 2000 levels), the starting point is year 2009, assume mortality reduction goal is achieved at a given year (e.g. 2012
for the 90% mortality reduction goal, and 2025 for the 98% mortality reduction goal) and carry out economic analysis for a total of 20 or 50 years. Calculate the CE analysis using the WHO recommended strategy with at least 90% routine vaccination coverage and a second opportunity of measles vaccination (through campaigns or routine second dose). Once the mortality reduction goal is achieved, use the same strategy to sustain the percent mortality reduction and include new technology vaccines as a scenario of future options.

3. To account for the cost and the benefits of using MR or MMR vaccine, a separate analysis should be carried out taking into account the cost of using MR or MMR. The additional benefits of preventing rubella and CRS should also be accounted for.

4. For the above scenarios, identify sources of uncertainty (variables that are likely to influence the outcome) for sensitivity analysis. These include:
   - the date when eradication/mortality reduction is achieved
   - the global coverage levels for routine measles vaccination.

5. The WHO secretariat will coordinate distribution of the findings of the economic analysis and share information with other areas of work within the overall WHO feasibility of measles eradication project.

**Model requirements**

Since future strategy options (including new technologies) will be considered and given the highly infectious nature of measles, dynamic mathematical modelling will be required. The latter will allow the analyst to assess whether the negative externalities from the above described strategy options will exceed the positive externalities. In order to account for the impact of using Rubella containing vaccines for measles eradication, a dynamic model for rubella and CRS is also needed. Models should take into account population projections and changes in cohort sizes over time.

**Costing and cost-effectiveness methods**

Cost, cost-effectiveness analysis and vaccine modelling should adhere to the recently developed WHO Guide for standardization of immunization programmes (2008). As a consequence:

- As an outcome provide measles cases and deaths averted and disability adjusted life years (DALYs) averted for each of the scenarios shown above.
- The analysis should be carried out from both a societal perspective and a health systems perspective.
- Total costs of measles mortality reduction/eradication should be based on the ingredient approach: i.e., country-level estimates of operational and health systems costs including treatment costs should be broken down by items used (i.e., number vaccines, personnel, vehicles etc.).
- Health sector costs should be included taking into account health sector efficiency improvements and synergy effects over time resulting in cost reduction.
- Costs should include the cost of surveillance and the cost of response to outbreaks; the cost of existing and new technologies.
- For countries that have eliminated measles, include in the analysis the costs of strategies that must be kept in place in order to sustain elimination in the presence of the ongoing risk of importations.
- Include the cost of outbreak response for endemic settings and in settings where elimination has been achieved where outbreaks occur as result of importations.
- Data elements should be obtained from countries which are representative of each of the WHO regions. Data should be obtained from published studies or through secondary data collection. In addition primary data obtained from country visits of other studies will be made available.
- For benefits, include the effect of eradication/mortality reduction on morbidity and mortality due to measles (and rubella and CRS where MR or MMR are used)
- Using published data compare the cost-effectiveness of measles eradication/mortality reduction to other public health interventions.

**Deliverables**
- A summary of a thorough literature review summarizing all cost and cost effectiveness analysis of measles vaccination/mortality reduction/eradication.
- An economic model which provide the information needed to assess the feasibility of measles eradication
- A report which will result in a published peer-reviewed journal paper.

**Time frame:**
Work to be completed by the end of April 2010.

**Selection Criteria:**

The following criteria will be used to review and select the submitted proposals:

- Proven track record and relevant expertise of the individuals and the organization submitting the proposal in:
  - carrying out cost-effectiveness analysis in public health
  - developing and using dynamic disease models
- Clear indications of the methodology to be used, data sources, proxies used (in the absence of good quality data), and assumptions used in the analyses.
- Clear identification of potential problem areas and consideration of alternatives
- Demonstration of knowledge of published literature in the specific area of work