Rapid assessment of Schistosoma mansoni: the validity, applicability and cost-effectiveness of the Lot Quality Assurance Sampling method in Uganda

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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
The study examined the Lot Quality Assurance Sampling (LQAS) method, used for parasitological screening of schools and communities to identify those at highest risk of morbidity from schistosomiasis. An extensive description of the statistical approach was provided. In brief, a series of sampling plans are developed to select a maximum sample size (n) and the number of cases (d) that are allowed in the sample of n before deciding that a community is a high prevalence community. The combination of maximum sample size (n) and number of defects (d) forms the stopping rules of the sampling plan, such as the sampling stops when either the maximum sample size (n) is met or the allowable number of cases (d) is exceeded. The values of n and d used in a sampling plan depend upon the threshold values used in the classification system and the acceptable levels of risk. Two threshold values were considered. High prevalence corresponded to more than 50% of children at high risk, while moderate prevalence corresponded to between 20 and 50% at high risk.

Type of intervention
Screening and treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised schoolchildren.

Setting
The setting was the community. The economic study was carried out in Uganda.

Dates to which data relate
The effectiveness and resource use data were gathered in 2003 and 2004. The price year appears to have been 2003 or 2004.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively on the same sample of patients as that included in the effectiveness study.

Study sample
Following the testing of the LQAS method using computer-based simulations based on data for 13,800 children in 202 schools, one of the 11 plans achieved by computer simulation was implemented in 34 schools in Uganda. At the schools in the identified areas, samples of 15 children (as defined by the sampling plan, obtained via simulation) from class 4 were selected using a random number table and asked to provide stool samples. Subsequently, a survey of 50 children from class 4 (whether or not they had been initially selected) was asked to provide a stool sample. Overall, 23,188 schoolchildren were considered. The survey team comprised a driver, a parasitologist and a technician.

Study design
This was a diagnostic study. The participating children were identified randomly from among all those attending the schools considered in the study. The intervention was implemented in two specific geographic areas in Uganda. More specifically, 12 schools of Kigandalo Subcounty, Mayuge District along the shores of Lake Victoria, and 22 schools in Pakwach and Panyimur subcounties, Nebbi District along the Albert Nile. Microscopic examination of 50 randomly selected schoolchildren using the compound microscope was considered the 'gold' standard for determining the accuracy of the two screening strategies. No follow-up was performed.

Analysis of effectiveness
The primary outcome measures were the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

Effectiveness results
The computer simulation showed that simulated plan of 15 schoolchildren was associated with a sensitivity of 94.8%, a specificity of 97.5%, a PPV of 88.5% and an NPV of 98.9%.

The proportion of children correctly classified with the simulated plan of 15 schoolchildren was 0.906.

The field testing showed that in the 1,687 children sampled, using LQAS in comparison with conventional sampling (50 children in each sample), the prevalence of S. mansoni was 28% (range: 2 - 84).

For the detection of children at high prevalence, the sensitivity was 100%, the specificity 96.4%, the PPV 85.7% and the NPV 92%.

For the detection of children at high and moderate prevalence, the sensitivity was 77.8%, the specificity 60.0%, the PPV 100% and the NPV 76.5%.

Clinical conclusions
The authors stated that, in general, sampling plans with moderate maximum sample sizes (i.e. n >/= 15) provided acceptable proportions of correct classification coupled with extremely low probabilities of making gross classification errors.

Measure of benefits used in the economic analysis
It was unclear whether a summary benefit measure was used.

Direct costs
The cost analysis was undertaken from the perspective of the control programme. It included the costs of the programme and the costs of treatment. The programme costs were grouped as personnel, capital and consumables. The unit costs were presented separately from the quantities of resources used for almost all items. Resource use was estimated prospectively for the sample of individuals included in the effectiveness study. The source of the unit costs was unclear. Capital costs were assumed to last 5 years and were annualised using a discount rate of 3%. Other costs were not discounted as annual estimates were calculated. The price year might have been 2003 or 2004.
Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
The indirect costs were not considered.

Currency
US dollars ($). The costs were converted from Ugandan shillings into US dollars using the 2003 mid-year exchange rate of $1 = shillings 1,943.

Sensitivity analysis
A one-way sensitivity analysis was undertaken to investigate the effect of the proportions of schools with 50% prevalence or more, and of the cost per child treated, on the cost-effectiveness of the alternative sampling methods versus a mass treatment strategy. A threshold analysis was also carried out.

Estimated benefits used in the economic analysis
Not relevant.

Cost results
The total costs per school were $20.04 with the LQAS method and $56.20 with conventional sampling. The financial saving of LQAS was due principally to lower costs associated with personnel and reduced drug costs from wastage.

The number of high-risk schools treated was 8,184 with the LQAS survey, 9,548 with the conventional survey, and 23,188 with mass treatment.

The estimated total costs were $3,055 with the LQAS survey, $4,680 with the conventional survey, and $6,725 with mass treatment.

The authors stated that the cost per high-prevalence school treated was $218 with the LQAS survey, $334 with the conventional survey, and $482 with mass treatment.

The sensitivity analysis showed that the cost-effectiveness of mass treatment was inversely and nonlinearly related to the proportion of schools with a high prevalence. Only when over 75% of schools had 50% prevalence or more did the LQAS screening become less cost-effective (i.e. more expensive) in comparison with mass treatment. Assuming 41% of schools had 50% prevalence or more, mass treatment was only cost-saving relative to screening using the LQAS for a treatment cost of less than $0.19 per schoolchild.

The authors noted that the current cost per schoolchild treated by the Ugandan programme was $0.29.

Synthesis of costs and benefits
It was unclear whether the costs and benefits were combined.

Authors' conclusions
The Lot Quality Assurance Sampling (LQAS) method was a cost-effective diagnostic strategy to guide decision-makers in allocating finite resources for the control of schistosomiasis in Uganda. The LQAS method required a much smaller sample size than the conventional sampling approach. Parasitological screening based on LQAS remained cost-effective in comparison with mass treatment for settings where prevalence was 50% or greater in 75% of schools, and for a cost
per schoolchild treated of below $0.19.

**CRD COMMENTARY - Selection of comparators**
The selection of the comparators was appropriate as the LQAS method was compared with the conventional sampling approach and mass treatment without screening. The authors justified their choice of the comparators on the grounds that they represented the standard approaches. You should decide whether they are valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness evidence came from a diagnostic study. The participating individuals were identified from within the same group of schools. The definition of the 'gold' standard appears to have been appropriate. Details of the study participants were not reported, and limited information on the methods used to assess the outcome was provided. The analysis focused on the implementation of a sampling approach derived from computer simulations.

**Validity of estimate of measure of benefit**
No summary benefit measure appears to have been used in the analysis because a cost-consequences analysis was conducted. Please refer to the comments in the 'Validity of estimate of measure of effectiveness' field (above).

**Validity of estimate of costs**
The cost analysis was undertaken from the perspective of the control programme. A micro-costing approach was used to identify the costs, and details of the unit costs and quantities of resources used were provided. This makes it possible to replicate the analysis in other settings. The source of the unit costs was unclear and the price year was not reported, which makes reflation exercises in other settings difficult. The cost estimates were treated deterministically and only a few items were varied in the sensitivity analysis.

**Other issues**
The authors stated that their findings were comparable with those from other studies carried out in comparable settings, like Burundi. The issue of the generalisability of the study results to other settings was not explicitly addressed and few sensitivity analyses were performed. This may limit the external validity of the study. In general, it was not totally clear whether cost-effectiveness ratios were calculated.

**Implications of the study**
The study results supported the use of LQAS sampling for the control of schistosomiasis in Uganda. The authors noted that future studies should further investigate the effectiveness of LQAS screening after multiple rounds of treatment.

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