

BRIEF REPORTS

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Cost of Syrup Versus Capsule Form of Vitamin A Supplementation

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The study was done to estimate the cost of each dose of vitamin A (2,00,000 Units) to the health system when delivered as a capsule, applicap or as syrup form. The cost of distribution of vitamin A supplements was estimated for the manufacturers, district and delivery level. The lowest cost per dose was for capsules in plastic jar (Rs. 0.99) and the highest was for the syrup in glass bottle (Rs. 1.29), the option currently being practiced. The distribution costs were least for the capsule, which compensates for its higher production cost. The cost of syrup was also more due to high degree of wastage compared to capsules. While cost is an important issue, other operational factors need also to be considered.

Key words: *Cost, Supplement, Vitamin A.*

Globally, approximately 21% of all children suffer from vitamin A deficiency, with the highest prevalence being in South-East Asia(1). A survey in nine states of India in 1999-2000 showed the average intake of vitamin A in children between 1 to 3 years of age to be 106 µg against the recommended dietary allowance of 400 µg. It varied between 71 µg in Andhra Pradesh to 171 µg in West Bengal(2).

In India, currently under the Reproductive

and Child Health (RCH) program, vitamin A supplementation is being carried out to children from six months to three years in the syrup form. The first dose of 1 ml (1 ml = 100,000 units) is given along with measles vaccine at nine months of age and subsequently six monthly doses of 2 ml are given till three years of age. However, despite many years of the program the coverage rates are low. As per the second National Family Health Survey (NFHS-2) in 1998-99, in the

country as a whole, only 3 out of 10 children aged 12-35 months ever received at least one dose of vitamin A. Only 17% of these children had received vitamin A in the previous six months(3).

The possible reasons for low coverage could include operational problems during distribution of syrup. The recent experience with possible improper dosing of vitamin A solution has focused attention on formulations of vitamin A. It is believed that problems can be minimized if vitamin A is provided in capsule form. India is, probably, the only country where vitamin A solution is used for the prophylactic program; all other countries use capsules. The reasons for this are not clear but could include historically non-availability of indigenous technology to manufacture gelatin capsules and possibly high cost of capsules. While the country now has the capability to produce gelatin capsules, the cost issue needs to be addressed. We have examined the cost of each dose of vitamin A (2,00,000 units) to the health system when delivered as a capsule/applicap or syrup form to the community as part of the national program.

Methods

The cost of distribution of vitamin A supplements were divided into three levels based on operational issues.

Level 1 – Above District

A visit was made to the Vitamins and Fine Chemicals Division of Nicholas Piramal Group in Thane, Maharashtra, the manufacturers of vitamin A in the country. The information about the cost of vitamin A solution, packaging costs of various forms like bottles, capsules, blister packs, etc and freight charges came from discussions with the marketing department of this firm.

Level 2 – From District to Subcentre

This was based on interviews with the District Family Welfare Officer, Faridabad, and Medical Officers of the Primary Health Center (PHC) in the same District and supported by personal experience of the authors. However, as currently all vitamin A is supplied as a part of the kit, the vitamin A cost was estimated based on relative space/weight(4). It should also be noted that even if there is a space saving by using capsules, it may not be translated to actual savings as the size of the kit box may not undergo any change.

Measurement of costs

Storage costs were estimated based on space-time utilization(4). The annual cost of the store was calculated as per the market rental charges of the space equivalent to the existing store. Transportation costs were estimated based on rentals of existing modes of transport for the distance expected. Handling costs included mainly the time spent by the storekeeper/helper in handling the stock and doing paper work.

Level 3 – Field level/Outreach session

Manpower and distribution costs were estimated based on a time-motion study on the workers during a vitamin A distribution session in the field(5). The session with syrup was one of the routine sessions in district Faridabad. The session with capsule forms of vitamin A was conducted with commercially available capsules. Also, a visit was made to Lucknow to interview Anganwadi workers who were using vitamin A capsules in a research project. Wastage was estimated based on interviews with workers and PHC data (doses received and distributed in a year) and relevant literature review. In order to adjust for wide variation in assumptions of critical

determinants of cost like wastage, drug costs, etc a sensitivity analysis was performed using different assumptions.

Some of the possible costs were not included in the analysis. This included training costs of the workers in the use of applicaps, scissors for removal of tips of applicaps and the intangible cost of messiness, towels, etc for syrup based supplementation. For all practical purposes, this study, capsules and applicap were considered as identical. The only difference would be in the mode of administration. While capsules are swallowed, applicaps cut and their contents squeezed into the mouth of the children.

Results

The costs are described for each level separately and added to get the total cost.

Above District level

The cost of producing the vitamin A solution was same for all dispensations (*Table I*). This was Rs. 31.60 per 100 ml or 31.6 paise per 100,000 units. If given as syrup, there was no conversion cost. For capsules, there was a conversion cost, which varied by packaging in a bottle jar, a plastic jar or in blister packs. As expected the cost of capsules in blister pack was highest (36% higher than solution in bottle). Freight costs to district head quarters were estimated as Rs. 8 per kg.

District to Sub-centre level

Storage and handling

These kits were not stored for very long at District level. They were almost immediately sent to the PHCs by road using the vehicles available at District level. The actual cost of storage was therefore minimal.

Transport

The supplements were transported from district level to PHC by jeep. The transport was usually done for many PHCs simultaneously so that a vehicle was shared by about 5 PHCs. The hiring charges of a jeep was Rs. 800 per day.

PHC Cost

Storage and handling were same as above and negligible. The cost of transport would be half of the above as the number of subcentres and distance was less.

Overall, this cost at District and PHC level was estimated at about 2 paise per dose of 200,000 units for the syrup. Based on the weight and volume (main determinants of storage and handling cost), it was estimated that the cost of capsules would be about half of the syrup.

Delivery Costs at Field Level

Two sessions, each by the same worker,

TABLE I—*Cost (in paise) of One Dose of Vitamin A (200,000 International Units (2 LIU)) at the Point of Delivery at District Level.*

Preparation	Cost*	Freight charges	Incidental charges @ 10%	Total cost
Solution in glass bottle	68	3.2	0.68	71.88
Capsules in glass bottle	87.6	0.78	0.88	89.26
Capsules in plastic jars	85.8	0.36	0.86	87.02
Capsules in blister pack	92.8	0.7	0.92	94.42

* This includes the cost of vitamin A solution, conversion to the appropriate form, packaging and labeling costs.

@ Incidental charges to the manufacturers including cost of sales, promotion, etc.

were observed with syrup and capsules. The capsules were also cut and dispensed as applicaps. This was done as applicaps of vitamin A were not available in the market. In these sessions, only vitamin A supplement were distributed and immunizations not given to get accurate information on this activity. This may have resulted in underestimation of time for administration, especially for syrup form of supplement as giving immunization simultaneously may involve more hand wipings *etc.* After the session was over the total time taken by the worker was divided by the number of doses given to get the estimate for mean time taken per dose. On an average there were about 25 doses administered in each session.

The average time taken for giving one dose of vitamin A was 38 seconds for the solution given by spoon, 8 seconds for capsules to be swallowed and 25 seconds for applicaps to be cut and squeezed. The opportunity cost of the time, estimated on the salary of the health workers of Rs. 8000 per month, was 42.4 paise, 9 paise and 28 paise respectively for each dose respectively.

Wastage

Data regarding total doses received and distributed were collected from one PHC for estimation of wastage. It was found that the doses distributed were in excess of doses received (even after adjusting for 1 ml dose in infants). As there was no supply of vitamin A from other sources, it was thought that an actual amount of 2 ml was not being given. This was tested in a session where the amount of vitamin A in the spoon, at the time of administration to the child, was only 1.5 ml. On recalculation, the wastage using 1.5 ml dose was 7%.

The estimate provided by the District Family Welfare Officer, Faridabad was 5%.

A previous report had estimated wastage of 6-8 doses, while the denominator was not mentioned, it is assumed that this was per bottle of 50 doses, a wastage of 12-16% (6).

For the capsules, the estimation of wastage based on interviews with the Anganwadi workers was about 2%. The wastage was mainly because some applicaps were empty and some were wasted during administration of the applicap.

The cost of providing vitamin A supplement to children by different forms is shown in *Table II*. The lowest cost per dose was for capsules in plastic jar (Rs. 0.99) and the highest was for the syrup in glass bottle (Rs. 1.29), the option currently being practiced. The production cost was lowest for vitamin A solution and highest for the capsules in blister packs. The charge from solution to capsules resulted in increase in cost from 26-36% depending upon the type of packing. The cost from District Subcentre was minimal and formed a very small part of the total cost. The distribution costs were least for capsules as they were swallowed. The higher cost of production of capsules was almost compensated by the lower cost of distribution due to the shorter time taken in its administration. The cost of syrup increased due to high degree of wastage compared to the capsules.

Sensitivity analysis

We varied some of the important assumptions used in the evaluation so as to see how it would affect the cost estimates.

Cost of supplement

The manufacturing costs of vitamin A might reduce if the requirement is large. This would occur if the Government shifts to the capsule form of supplement. For the syrup, this was 2 paise per dose, while for the capsules it was estimated by the manufacturers

TABLE II—Total Cost (in Paise) of Administration Vitamin A Supplement of 200,000 IU

Preparation	Till district level	Storage and transportation	Distribution	Cost	Adjustment for wastage	Actual Cost	
						Paise	Rs.
Solution in glass bottle	71.90	2.0	42.4	116.3	1.111	129.2	1.29
Capsules in glass bottles	89.26	1.0	8.9	99.16	1.0204	101.2	1.01
Capsules in plastic jars	87.02	1.0	8.9	96.92	1.0204	98.9	0.99
Capsules in blister pack	94.42	1.0	8.9	104.32	1.0204	106.4	1.06
Applicaps in glass bottles	89.26	1.0	27.9	118.16	1.0204	120.6	1.21
Applicaps in plastic jars	87.02	1.0	27.9	115.92	1.0204	118.3	1.18
Applicaps in blister packs	94.42	1.0	27.9	123.32	1.0204	125.8	1.26

that a maximum likely fall is about 10% *i.e.*, about 8-9 paise. Thus, the results would be more in favour of the latter.

Time taken

Our assumptions were based on the time motion study carried out especially for this study. We do not have estimates from other researchers for comparison. It should be noted that the workers were familiar with the use of syrup and unfamiliar with the use of capsules. Therefore, it is possible that after regular use, the time taken for the latter may be lower than estimated.

Wastage

For the capsules we used only one estimate. However, for the syrup form we had estimated a range from 6-15%. If we assume a wastage of 5%, the cost per dose of syrup comes out to be Rs. 1.21. With an assumption of 15% wastage, the cost per dose of syrup increases to Rs. 1.36. Thus, a change in assumption towards the lower side in a syrup

form makes it cheaper than the capsules.

Discussion

We tried to estimate the cost of supplementation of vitamin A in syrup and capsule forms from the viewpoint of the national program. While the cost of the supplement for capsule was higher compared to syrup by about Rs 0.20 per beneficiary, this would be balanced by a better operational efficiency of the delivery system, less wastage and a possible improved coverage by the former. While the use of capsules by the health workers results in a saving of their time, from the Government's view this would be merely notional and not actual savings. However, this should be considered important as this leaves the worker to use that time in a more productive manner for other programs and activities.

Ching *et al.* based on international experience, estimated that the incremental cost of adding distribution of vitamin A capsules to

polio campaigns would be US\$ 0.110 and the average cost would be US\$ 0.43(7). The cost of vitamin A supplement used was US\$ 0.02. The rest of the incremental cost of adding vitamin A to polio campaign (US\$ 0.08) was attributed to training, personnel, logistics and supplies (tally forms, scissors and containers). The estimate of US\$ 0.02 (Rs. 0.96) is quite close to about Rs. 0.90 arrived at in this study. We estimated the total cost of vitamin A and its distribution to be about Rs. 1.00 (capsules in glass or plastic bottles) per dose compared to a US\$ 0.10 (Rs. 4.80) by Ching *et al.* We did not include the training costs, supplies and the record maintenance, all of which are important activities. Recent experience has shown that training in administration of vitamin A is

of paramount importance. The difference between the two estimates is probably due to the differences in the cost of the personnel and supplies at national and international level.

Comparison of other operational issues

While cost is an important consideration, other issues that should be kept in mind are listed in *Table III*.

Currently, the gelatin for the capsules comes from animal sources, though recently capsules from plant sources have become available at similar costs. The messiness of syrup form and its possibility of improper measurement (both on lower as well as higher side) are important considerations for

TABLE III—*Non-economic Issues in Capsule, Applicaps and Solution.*

	Syrup	Capsule	Applicaps
<i>Production level</i>			
Availability of indigenous technology	Available	Available	Available
Non-vegetarianism	No Problem	Problem	Problem
<i>Storage and handling</i>			
Breakage	Possible	Possible if packed in glass bottles	Possible if packed in glass bottles
Weight	Heavier to carry	Lighter	Ligher
<i>Delivery</i>			
Messiness	Major problem	Absent	Minor problem
Breakage of bottle	Possible	Possible if packed in glass bottles	Possible if packed in glass bottles
Cleanliness of spoon	Problem	Not applicable	Not applicable
Contamination with saliva	Problem	No	No
Refusal due to multiple use of single spoon	Yes; caste factor	No	No
Administration of incorrect amount	Possible-lesser or a higher dose depending on the size of spoon	Unlikely	Possible lower dose due to improper squeezing
Difficulty in swallowing	Yes; oily and bad taste; needs masking by flavor	Yes; children <3 yrs not able to swallow	Yes; oily and bad taste; needs masking by flavor.

Key Messages

- India is the only country using vitamin A in solution form for supplementation in children.
- The cost of vitamin A supplements as capsules was estimated to be higher by about Rs. 0.20 per dose of 200,000 IU.
- The total cost of supplementation by capsules was less than that of syrup, mainly due to ease in administration and lower wastage.
- There is a need for the Government of India to review the current practice of administering vitamin A in syrup form based on the availability of indigenous technology and cost estimates.

switching to a capsule on applicap form of administration. While capsules seem to have the lowest cost, children between 6 months to three years may have problems in swallowing. Therefore, the applicaps option may be more suitable. Alternatives mode of vitamin A administration, like a dropper or pump, also need to be examined.

There is a need for the Government to review the current practice of administering vitamin A in syrup form based on the availability of indigenous technology, cost estimates and other operational issues and consider other modes of administration.

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manuscript. SKK helped in field studies, provided inputs for analysis and reviewed the manuscript. CS provided guidance on methodological issues and revised the manuscript.

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An Outbreak of Echovirus Meningitis in Children

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An outbreak of aseptic meningitis in children as evidenced by increase in the number of admissions in a tertiary care hospital is described. Clinical data and stool samples were collected from 25 hospitalized infants and young children. The stool samples were subjected to virological investigations. Fever and vomiting were the commonest symptoms. Cerebrospinal fluid (CSF) showed lymphocytic pleocytosis in majority of cases. Of the 25 stool samples, 14 showed an enterovirus specific cytopathogenic effect (CPE) in rhabdomyosarcoma (RD) cell line. All the 14 samples were positive for enterovirus RNA by reverse transcription-polymerase chain reaction (RT-PCR). Partial sequencing of the Virion protein 1 (VPI) region of the enterovirus genome carried out on the first 7 isolates revealed 5 isolates to be echovirus serotype 4 and one each to be echovirus serotypes 3 and 30. All children showed a rapid recovery and were discharged within 3 days of admission.

Key words: Aseptic meningitis, Enterovirus, Outbreak.

Enteroviruses are the commonest cause of aseptic meningitis with majority of cases attributable to Coxsackie and Echo viruses(1-3). Enteroviral meningitis occurs sporadically or as epidemics(1), with some of the largest outbreaks caused by echoviruses(4).

Though outbreaks of enterovirus meningitis are commonly reported from industrialized countries there are few documented reports from India. We report

here an outbreak of echovirus meningitis in Vellore and surrounding areas as evidenced by a sudden increase in the number of infants and children admitted to the pediatric wards of our hospital.

Subjects and Methods

An outbreak of enterovirus meningitis was suspected when there was a sudden increase in number of patients admitted with a diagnosis