Options for Diarrhoeal Diseases Control

The cost and cost-effectiveness of selected interventions for the prevention of diarrhoea

A study supported by
The Diarrhoeal Diseases Control Division
World Health Organization

Evaluation and
Planning Centre
for Health Care

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Margaret A Phillips
Richard G Feachem
Anne Mills

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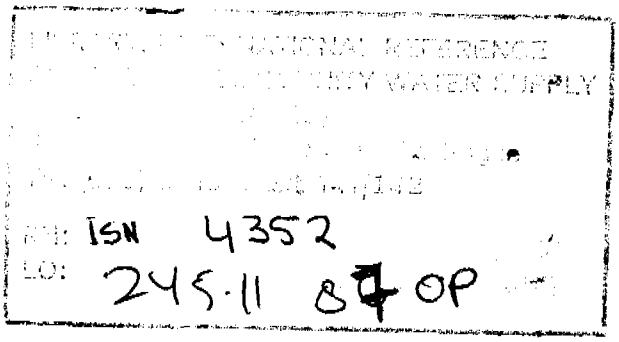

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I INTRODUCTION

Diarrhoea is estimated to be responsible for the deaths of nearly five million children under 5 years of age annually (Snyder and Merson 1982). A major breakthrough in the treatment of diarrhoea was achieved in the 1960s with the demonstration that a solution of salt and sugar of specific molarity could be administered orally to prevent dehydration and consequently death. Oral rehydration therapy (ORT) was found to be effective, relatively simple to administer and inexpensive; it has rapidly become a key component of the activities of many agencies and governments concerned with child survival in developing countries.

There are, however, limits to the extent to which ORT can be expected to provide the solution to the problem of diarrhoea. In the first place, while demonstrably effective in preventing death resulting from acute watery diarrhoea, ORT appears to have little impact on mortality resulting from dysenteric or chronic diarrhoeas which in some areas can be responsible for as much as 50% of diarrhoea deaths (Black, n.d.). Secondly, ORT can be expected to have little or no impact on morbidity rates of any type of diarrhoea.

For these reasons, the Division of Diarrhoeal Diseases Control (CDD) of the World Health Organization (WHO) initiated a research programme in 1982 to study systematically non-clinical interventions that might play a role in diarrhoea control (Feachem et al. 1983). Eighteen interventions have been identified, and evidence concerning their effectiveness analysed by an international group of specialists. Some have been found to be of limited effectiveness, not to be feasible or to be too costly; others require further research to determine their potential; and several show considerable promise (see Table 1.1). In this document we examine in further detail six interventions identified as promising:

- measles vaccination;
- rotavirus vaccination;
- cholera vaccination;
- breast-feeding promotion;
- improved weaning practices;
- personal hygiene and domestic hygiene promotion.

Analyses of the effectiveness or potential effectiveness of these interventions have been published (Table 1.1). In this document, our major focus is on the demands these interventions make on resources. The primary objective is to estimate the implementation costs incurred by the provider. The costs are combined with effectiveness data to develop estimates of cost per diarrhoea case or death averted. Such cost-effectiveness results are a potentially useful guide to decision-makers

Table 1.1. Potential non-clinical interventions for diarrhoea control among young children[1]

Area	Potential intervention	Reference to published effectiveness review	Status[2]
Maternal health	Preventing low-weight babies	Ashworth & Feachem (1985a)	?
	Enhancing lactation	Ashworth & Feachem (1985b)	-
Child health	Promoting breast-feeding	Feachem & Koblinsky (1984)	*
	Improving weaning practices	Ashworth & Feachem (1985c)	*
	Supplementary feeding programmes	Feachem (1983)	-
	Growth monitoring	Ashworth & Feachem (1986)	?
	Increasing child spacing	in preparation	?
	Vitamin A supplementation	Feachem (1987)	?
Immuno- and chemo-prophylaxis	Rotavirus vaccination	de Zoysa & Feachem (1985a)	*
	Cholera vaccination	de Zoysa & Feachem (1985a)	*
	Measles vaccination	Feachem & Koblinsky (1983)	*
	Chemoprophylaxis	de Zoysa & Feachem (1985b)	-
Interrupting transmission	Improving water supply and sanitation facilities	Esrey et al. (1985)	*
	Promoting personal and domestic hygiene	Feachem (1984)	*
	Improving food hygiene	in preparation	?
	Controlling zoonotic reservoirs	in preparation	?
	Controlling flies	in preparation	-
Epidemic control	Epidemic surveillance, investigation and control	in preparation	?

1. Adapted from Feachem (1986)
2. Status: - interventions which are ineffective and/or of limited feasibility.
   * effective interventions.
   ? interventions of uncertain effectiveness and/or feasibility.

wishing to make the best use of limited resources by choosing approaches which will have maximum impact on diarrhoea for a given level of investment. Because of the dearth of cost data, it has sometimes been necessary to construct plausible costings by postulating likely quantities of inputs and price levels. Frequently, even project descriptions on which to base such costings are poor. Indeed, it has been an important secondary objective of this research to elaborate, where necessary, on the nature of the interventions and provide detailed characterisations of them. In some cases, this process has helped to elucidate the range of strategies available within any one type of intervention, and has provided guidance for those interested in aspects of implementation. The resulting cost-estimates are, inevitably, somewhat speculative, and are presented with the intention of provoking more research and data publication in this field. The identification of lacunae in the data and recommendations for research has been a further purpose of this investigation.

While adopting common measures, namely cost per diarrhoea episode and per diarrhoea associated death averted, the method for calculating these has been rather different for each of the interventions - largely as a consequence of the nature of the data available. This document, therefore, illustrates the variety of approaches that can be employed in determining rough estimates of cost-effectiveness from evidence in the literature. For vaccination programmes, for example, there is a relatively substantial body of cost data. In the chapter on measles, rotavirus and cholera vaccination we develop a model to describe how costs of existing programmes are likely to change with the addition of new vaccines and then estimate the incremental cost per child fully vaccinated with each of these anti-diarrhoea vaccines. There are clearly advantages in this approach, which uses actual expenditure data for estimating costs of an intervention. Unfortunately, for some other interventions such data are scarce. For breast-feeding promotion, for example, it was necessary to give considerable attention to defining the major strategies possible and, in the absence of expenditure data, to describing the kinds of resource implications for each of these in order to build up cost estimates. This "ingredients" approach relies on accurately identifying the components of the strategy, a difficult task when even descriptive data are scarce.

Putting together cost and effectiveness data from essentially different sources is an unfortunate necessity for the vaccination and breast-feeding promotion calculations. Weaning education is one area where cost and effectiveness studies have been undertaken on the same project and we take advantage of these, analysing them in some detail to determine likely ranges of cost-effectiveness. Hygiene promotion is an intervention for which there is little published information, even on effectiveness. We examine some of the few studies that have measured impact, to ascertain the nature and scale of resources required and derive estimates of costs for each of these projects. Some strategies, such as education through health centres, are relevant to more than one type of intervention. To avoid repetition we analyse these in detail for the intervention for which they appear to have most potential.

The final chapter brings together the results of the analyses of the six interventions, comments on these and their limitations, and identifies areas for further research. In particular, we draw attention to the costs and benefits not captured by the measure of cost per diarrhoea episode or death averted. These other consequences are substantial for some interventions and may be crucial in influencing decisions as to where resources will be invested.

Note

Throughout the text amounts of money expressed in dollars are given in US dollars 1982.

II VACCINATION AGAINST MEASLES, ROTAVIRUS DIARRHOEA AND CHOLERA

2.1 Background

A considerable body of evidence, reviewed by Feachem and Koblinsky (1983), suggests that measles vaccination can have a modest impact on diarrhoea morbidity and a substantial impact on diarrhoea mortality. New oral vaccines against cholera and rotavirus diarrhoea are under field trial and their potential impact has been analysed (de Zoysa and Feachem 1985a). Rotavirus vaccines should play an important role in reducing diarrhoea illness and death in children under 2 years of age throughout the developing world, while new cholera vaccines may provide an effective intervention in countries, such as Bangladesh, with relatively high rates of endemic cholera.

In this chapter we assume that a vaccination programme already exists and explore the cost of adding measles, rotavirus or cholera vaccinations to that programme. Most countries do have vaccination programmes against at least some of the six major immunisable childhood diseases (tuberculosis, diphtheria, pertussis, tetanus, polio and measles), with trained staff, vehicles, refrigerators and an administrative and supervisory network. In the relatively few areas where no programme yet exists, it is unlikely that consideration would be given to establishing a programme just for rotavirus or cholera (measles perhaps) without including vaccines such as DPT (diphtheria, pertussis and tetanus) and OPV (oral polio vaccine) whose value is well established since the fixed costs involved in developing the basic infrastructure of a vaccination programme are substantial. In those countries where no vaccination programme is operating, the more appropriate intervention to cost would be the whole package of vaccinations, a task beyond the scope of this analysis.

2.2 Description of the intervention

The nature of the requirements for operating vaccination programmes successfully are broadly similar whatever the vaccine: vaccines themselves; facilities to house, transport, keep cool and administer the vaccines; and staff time to administer, record, supervise and manage the

vaccines. These inputs are utilised at several different levels in a vaccination programme - the vaccination site and district, regional and national levels. Some of these inputs, such as the vaccine itself, will increase when a new vaccine is added to an existing vaccination programme; others, such as central management costs, may remain relatively unchanged. Exactly what costs need to increase will depend somewhat on the nature of the new vaccine being added and, in particular, on how compatible the new vaccine is with the existing vaccination schedule. A new vaccine which can be administered with an existing vaccine and in the same dose probably involves little additional cost over that for the vaccine itself. On the other hand, a vaccine administered in several doses and requiring separate visits to the health service will also demand additional staff and possibly transport and promotional resources.

The schedule and dose for measles vaccine are reasonably well established: a single injected dose at 9 months is recommended in most developing countries. New cholera and rotavirus vaccines are still in the development stages and their schedule and doses are less certain. It is expected that rotavirus vaccine will be administered orally either as a single or a triple dose between 1 and 6 months, possibly in combination with OPV. For cholera, the administration schedule is more tentative: two or three oral doses in the second year of life is one possible schedule. We shall assume that the schedules will be:

- one injected dose of measles vaccine at about 9 months;
- three oral doses of rotavirus diarrhoea vaccine before 6 months;
- three oral doses of cholera vaccine in the second year of life.

Table 2.1 summarises these and other key characteristics of the three vaccines reviewed here and five other vaccines commonly used in childhood vaccination programmes.

Four scenarios, intended to encompass the likely modes of administration of the new vaccines, are considered:

- where the new vaccine is combined with an existing vaccine and administered in the same dose (possibly rotavirus);

- where the new vaccine is administered in a separate dose but, at the same time as an existing vaccine (possibly rotavirus);
- where the new vaccine is administered at a new contact outside the current schedule, but at an age at which children are likely to be brought to the health services for other reasons (e.g. measles);
- where the new vaccine is administered at a new contact and at an age when healthy children are not normally brought to health services (e.g. cholera).

Table 2.1. Characteristics of vaccines indicating compatability of measles, rotavirus diarrhoea and cholera vaccines with expanded programme on immunization (EPI) (minus measles) vaccines for children

Vaccine	No. of doses	Timing of doses	Route of administration	Stability at 37 °C
BCG	1	From birth	Intradermal injection	Approx. 1 week
DPT	3	From 6 weeks at intervals of 4 weeks	Intramuscular injection	Approx. 1 week
OPV	3	From 6 weeks at intervals of 4 weeks	Oral	Approx. 1 day
Measles	1	From 9 months	Subcutaneous injection	Approx. 1 week
Rotavirus diarrhoea	1-3?	Possibly same time as OPV	Oral, possibly with OPV	Similar to OPV
New cholera	3?	Probably 2nd year of life	Oral (killed)	Relatively heat stable
			Oral (live)	Relatively unstable

2.3 Cost estimates

In contrast to other interventions against diarrhoea explored in this paper, there exists a substantial literature documenting cost breakdowns for vaccination programmes in several countries (Tables 2.2 and 2.3).

Table 2.2. Vaccination costs per fully vaccinated child

Country (reference)	Vaccines delivered	Strategy	Cost per CFV (local currency & date)	Cost per CFV ($US 1982)
Brazil	Full EPI	(i) Routine (static)	4671 cruzeiros (1982)	26.0
(Creese 1982)	Full EPI	(ii) Intensification (outreach)	1579 cruzeiros (1982)	8.8
(Creese 1984)	Polio	(iii) Campaign (mobile)	378 cruzeiros (1982)	2.1
Cameroon (Ahmed 1982)	Full EPI	Mixed (static/mobile)	2758 francs (1981)	9.5
Gambia (Robertson et al. 1982)	Full EPI	Mixed (static/mobile)	38 dalasi[1] (1980/81)	19.2
			24 dalasi[2] (1980/81)	12.0
Ghana (Litvinov et al. 1979)	Full EPI	(i) Outreach	41 cedi (1979)	154.0
		(ii) Mobile	12 cedi (1979)	45.5
Indonesia (Creese 1981)	BCG, 2 DPT	Mixed (static/mobile)	1412 rupiah (1979)	2.6
Ivory Coast (Shepard 1982)	Full EPI	(i) Mobile unit - Abengourou	2628 francs (1980/81)	8.9
		(ii) Static centres - Abengourou	5432 francs (1980/81)	18.5
Kenya (Wang'ombe 1982)	Full EPI	Static	150 shillings (1981)	16.6
Philippines (Creese 1978)	BCG, 2 DPT	Outreach	30 pesos (1978)	6.2
Thailand (Creese 1980)	BCG, 2 DPT	Mixed (static/mobile)	217 baht (1979)	13.2

1. With expatriates
2. With expatriates

Table 2.3. Percentage breakdown of total costs of vaccination programmes by country[1]

Country	Salaries		Transport		Vaccines	Supplies	Other operating	Training	Capital		Publicity	Total
	Local	Central	Local	Central					Local	Central		
Brazil												
Static (i)	68	14	1	-	5	-	3	-	5	4	-	100
Outreach (ii)	44	13	13		11	-	2	-	17		-	100
Mobile (iii)	39	19	6	-	4	-	10	-	7		15	100
Cameroon												
With expats	44	16	8		13	-	5	-	14		-	100
Gambia												
With expats	23	42	7	3	7	6	-	2	9	14	-	100
Without expats	38	8	11	4	12	9	-	3	1	2	-	100
Ghana												
Outreach (i)	38	19	6	11	2	3	4	5	12		-	100
Mobile (ii)	41	18	12	7	4	2	-	1	15		-	100
Indonesia	25	12	5		22	-	10	8	13	5	-	100
Ivory Coast												
Mobile (i)	24	38[2]	8		17	-	-	-	13		-	100
Static (ii)	62	23[2]	-		10	-	2	-	3		-	100
Kenya	27	22	10[3]	22	3	-	-	-	16		-	100
Philippines	31	22	10	4	12	-	2	-	19		-	100
Thailand	29	20	9		13	-	3	-	26		-	100

1. For some countries these data are based on assessments of samples of health centres; for others they are disaggregations of national programme expenditure.
2. These costs include central vehicle and maintenance costs as well as salaries.
3. Including other operating costs.

These studies have not, in general, been concerned with estimating the additional (i.e. incremental) costs of adding a new vaccine to an existing programme, but have presented results in terms of the average cost of fully vaccinating a child with the range of vaccines provided by that programme. Nevertheless, these data provide a useful base from which it is possible to derive estimates of the extra cost of fully vaccinating a child with the "new" vaccines (measles, rotavirus and cholera). We adopt the following general approach. (See Creese (1986) for an alternative method).

(a) Estimates of the cost per child fully vaccinated (CFV) with the vaccines available in that particular programme (Table 2.2) and the breakdown of those costs into the major components shown in Table 2.3 are obtained from the data on existing vaccination programmes.

(b) For each of these major cost components, a "model" of how they are likely to change with the addition of different kinds of new vaccines is developed (Sections 2.3.1 to 2.3.7) and applied to the data collected in (a). The result is that, for each vaccination programme for which there are cost data, we derive an estimate of the extra cost in terms of salaries, transport, vaccines etc. of adding each of the "new" vaccinations to that programme.

(c) For each vaccination programme these cost components are then summed to give estimates of incremental cost per child fully vaccinated against measles, rotavirus diarrhoea or cholera (Section 2.3.8).

2.3.1. Salaries - local

Local salaries are a key input, not only because they contribute substantially to average costs (Table 2.3), but also because other costs (e.g. higher-level administration) are likely to be a function of local staff costs. Unfortunately, sufficiently detailed time allocation studies, necessary for any clear identification of major factors likely to influence time required by staff for vaccinations, have not been undertaken. In the absence of such data, it will be assumed that the

characteristics listed below are important in determining the local salary cost of fully vaccinating a child with a given vaccine. The basis and implications of these assumptions are discussed later (Section 2.6). To simplify the calculations we create a hypothetical standardised unit, the "injected-dose-equivalent" (IDE), which represents the amount of local staff time required to inject an injectable vaccine at an existing contact. (It does not include time for registration or preparation of the child.)

- route of administration. We assume that administration of an oral vaccine takes one-third of the time of an injected vaccine, i.e. it equals 1/3 IDE .
- schedule. We assume that a vaccine administered in the same dose as an existing vaccine involves no extra time; that a vaccine administered in a separate dose but on the same occasion as another vaccine only involves the time for actual administration of the vaccine (i.e. 1/3 IDE or 1 IDE depending on the route of administration); and that a vaccine delivered at a separate time from other vaccines (i.e. at a new contact) involves the administration time plus time for registration and preparation of the child. We assume that this registration and preparation time is equal to that required to administer an injected vaccine (i.e. 1 IDE).
- number of doses and the rate of drop-outs between contacts. Not all children who receive vaccines at any given contact will return for subsequent doses. We assume a constant drop-out rate between each contact of 10%.

Using these assumptions, it is possible to calculate the number of IDEs required per CFV for any given schedule. For example, take a full EPI schedule involving an average of five contacts: (1) BCG (injected); (2) DPT (injected) plus OPV (oral); (3) DPT plus OPV; (4) DPT plus OPV; (5) measles (injected). Given a drop-out rate of 10% between contacts, and assuming that neither BCG nor measles is administered with other vaccines, then for every CFV there will be on average 6.2 contacts, 6.2 injected doses and 3.7 oral doses. If, as we assume above, an oral dose takes one-third the time of an injected dose to administer and each new contact involves extra staff time equivalent to the time for an injection, then there are 6.2 + 6.2 + 3.7/3 = 13.6 IDEs for each CFV.

Table 2.4 shows the number of doses and contacts per child fully vaccinated with the vaccines provided in the vaccine schedules for which cost estimates are available, and converts these into the number of IDEs. Putting this together with the average local salary cost per child fully vaccinated for each vaccination programme, it is possible to calculate the local salary cost per IDE for each programme. Since the time required to fully vaccinate a child against the three anti-diarrhoea vaccines can be expressed in terms of IDEs (Table 2.5 footnote), an estimate of the local salary cost involved in vaccinating a child against the three diseases can be calculated for each programme (Table 2.5).

Table 2.4. Number of contacts, doses and IDEs in different schedules

Vaccination schedules[1]	Countries	Number of doses and contacts provided per CFV assuming 10% drop-outs			Number of IDEs per CFV[3]
		Contacts	Injected doses	Oral doses	
Schedule I BCG DPT(2)	Philippines Thailand Indonesia[2]	2.1	3.2	_	5.3
Schedule II (full EPI) BCG DPT(3) OPV(3) Measles	Ivory Coast Cameroon Brazil (i & ii) Ghana Gambia Kenya	6.2	6.2	3.7	13.8
Schedule III OPV(3)	Brazil (iii)	3.3	_	3.3	4.5

1. The number of contacts are those recommended for each schedule. Schedule I involves two: 1st for BCG and DPT(1), 2nd for DPT(2). Schedule II involves five: 1st for BCG, 2nd for DPT(1) & OPV(1), 3rd for DPT(2) & OPV(2), 4th for DPT(3) & OPV(3), 5th for measles. Schedule III involves a separate contact for each OPV dose. Schedules I and III represent the minimum number of contacts. Schedule II, however, could be given in as few as three contacts.
2. Indonesia's programme is included under schedule I although the programme also included smallpox given in the second contact. Indonesia's programme is one of the cheapest, and the consequences of this simplification will be to bias its results towards the average.
3. Injected dose: 1 IDE; oral dose: 1/3 IDE; contact time: 1 IDE.

Table 2.5. Local-level salary costs

Country	$ per CFV[1]	Local salaries as % of total costs[2]	Local salary cost per IDE ($US 1982)[3]	Local salary cost (US$1982) per child fully vaccinated[4] against:		
				Measles[5]	Rotavirus[6]	Cholera[7]
Brazil (i)	26.0	68	1.28	2.56	1.44	5.71
(ii)	8.8	44	0.28	0.56	0.31	1.25
(iii)	2.1	39	0.18	0.36	0.20	0.80
Cameroon	9.5	44	0.30	0.61	0.33	1.34
Gambia	19.2	23	0.32	0.64	0.37	1.43
Ghana (i)	140.0	38	3.84	7.71	4.28	17.22
(ii)	42.0	41	1.25	2.50	1.41	5.58
Indonesia	2.6	25	0.12	0.24	0.13	0.54
Ivory (i)	8.9	24	0.15	0.31	0.17	0.67
Coast (ii)	18.5	62	0.83	1.66	0.94	3.70
Kenya	16.6	27	0.32	0.65	0.37	1.43
Philippines	6.2	31	0.36	0.72	0.40	1.61
Thailand	13.2	29	0.72	1.46	0.80	3.21

1. From Table 2.2.

2. From Table 2.3.

3. $ per CFV x $\frac{\text{local salary cost}}{\text{total cost}}$ x $\frac{\text{CFV}}{\text{IDE}}$ ($\frac{\text{IDE}}{\text{CFV}}$ from Table 2.4).

4. i.e. local level salary cost per IDE x IDEs per child fully vaccinated with new vaccine.

5. Measles, as a single dose, injected, new contact vaccine involves time equivalent to 2 IDE (one for contact, one for injection) per CFV.

6. Rotavirus, as a triple dose, oral vaccine given in separate doses but with no new contacts involves time equivalent to:

$$1/3 \text{ IDE} + \frac{1/3 \text{ IDE}}{(1-0.10)} + \frac{1/3 \text{ IDE}}{(1-0.10)^2} = 1.115 \text{ IDE per CFV.}$$

7. Cholera, as a triple dose, oral, new contact vaccine involves time equivalent to:

$$4/3 \text{ IDE} + \frac{4/3 \text{ IDE}}{(1-0.10)} + \frac{4/3 \text{ IDE}}{(1-0.10)^2} = 4.461 \text{ IDE per CFV.}$$

2.3.2 Salaries - central

The responsibilities of higher-level vaccination staff include supervision of health centre staff, provision of personnel services for these staff, maintenance of buildings, record keeping, ordering vaccines and organising their delivery. The amount of central staff time devoted to vaccination matters is therefore likely to be a function of:

- the number of field-level vaccination staff;
- the number of health centres/mobile clinics;
- the number of vaccines.

Available data are not adequate to determine even roughly the nature of this relationship. If central level staff costs are largely a function of the number of vaccination centres (which is unlikely to change with the addition of a new vaccine), and if there is some excess capacity at central level to accommodate increased activity, then adding a new vaccine to an existing programme will have negligible impact on higher-level salary costs. Programmes with a relatively high proportion of total costs devoted to central salaries (e.g. Kenya) will probably require little extra central staff time with the addition of a new vaccine.

To avoid underestimating likely incremental central salary costs we assume that central staff costs increase with the introduction of a new vaccine in the following way:

- 50% of central salary costs remain constant, reflecting the existence of some excess capacity and the assumption that a proportion of central salary costs are a function of the number of health centres, which is assumed not to change;
- 25% of central salary costs increase in direct proportion to the increase in health centre salary costs;
- 25% of central salary costs increase in direct proportion to the increase in number of vaccines.

2.3.3 Transport

Transport costs at the local level will probably be a function of the number of outlying vaccination centres and sessions, and the distance between them. It is probably unnecessary to expand geographic coverage and to travel to new areas for the new vaccines - the same vaccinees or others in the same population are the target. Furthermore, at least for mobile/outreach services offering all vaccines at any visit (in contrast to special mass vaccination campaigns), it is possible to accomplish the additional vaccinations by having existing staff stay longer or by carrying extra staff in the same number of trips. We therefore assume that extra vaccinations are accomplished through increased staff time rather than additional use of vehicles.

2.3.4 Vaccines

Measles is the only one of the three vaccines examined here which is currently commercially available. Prices quoted for that vaccine are around $0.07 per dose (Creese 1986). Taking into account costs of shipping the vaccine and likely rates of wastage, not infrequently of the order of 50% (Robertson et al. 1982), an estimate of about $0.20 per dose administered would appear to be reasonable. This is not inconsistent with estimates of costs per dose averaged over all vaccines, derived from the costed vaccination programmes. Only three of the 13 programmes analysed have estimates of vaccine costs per dose outside the range $0.10-0.30. The median value is $0.15.

The likely costs of the new cholera and rotavirus vaccines are not yet clear. Rotavirus vaccine is relatively easy to culture and is expected to be roughly comparable in cost with measles (Creese 1986). New experimental vaccines are, at present, much more expensive, but costs are expected to fall substantially with commercial production. For lack of evidence to the contrary, cholera vaccine will be assumed to be similar in cost to measles and rotavirus. Most other vaccines are somewhat cheaper than measles. However, the likelihood that in the short term at least some dis-economies of scale in production will be experienced suggests that cholera and rotavirus vaccine costs per dose may, if anything, be rather more than that for measles. We adopt a

fixed cost per dose for measles of $0.20 and assume the same cost per dose for rotavirus and cholera vaccines.

2.3.5 Materials

Supplies of cotton wool, syringes, stationery and record cards will increase as a function of the number of extra doses and the number of vaccines. Other operating costs, which include electricity for operating the fridge and supplies for maintaining and cleaning vaccination centres, will probably be a function of the number of vaccination centres, the number of vaccines and the number of doses. For simplicity, we assume that these costs are directly proportional to the number of doses. The costs involved are relatively small and there is little to be gained from exploring alternative possibilities. These costs are likely to be less where the new vaccine is administered orally and does not require syringes and cotton wool (e.g. rotavirus and cholera vaccines).

2.3.6 Capital

In expanding an existing vaccination programme to encompass a new vaccine there are various new capital items which may be required. For example, there will be an additional quantity of vaccine which will place extra demands on storage facilities. In countries where vaccines presently used are relatively heat-tolerant and the new vaccine is more sensitive, a different cold chain system may need to be established. Additional staff time, or possibly new staff, may put pressure on buildings housing staff or on vehicles for transporting them. This will not necessarily be translated into additional costs, particularly if the additional workload is small relative to the existing one. There are, for example, a number of possibilities for absorbing any potential additional demand for new vehicles: underemployment of existing staff allowing additional doses without new staff; excess capacity in vehicles allowing more trips without a new vehicle. Some excess capacity might also exist with buildings and storage.

Evidence to suggest that capital costs remain reasonably constant with the addition of a new vaccine is provided by the observation that substantial changes in average costs of vaccination programmes occur

with changes in output levels (e.g. Creese et al. 1982), average costs falling as the number of vaccinations increases. Of all the costs incurred by a vaccination programme, capital costs are amongst the ones least likely to respond to a change in output. Furthermore, capital costs are less likely to rise with the introduction of a new vaccine (when the same group of children or a new group in the currently served population is the target) than with increased output of an existing one (when it is normally necessary to expand the geographic coverage which may involve more outposts or more vehicles).

To avoid underestimating incremental capital costs incurred with the addition of a new vaccine, we explore the assumption that 50% of local capital costs increase in direct proportion to the number of doses, while central capital costs remain unchanged. Only three of the programmes shown in Table 2.3 separate local and central capital costs. In these, the proportion of local to total capital costs lies on average around 70%. This percentage is applied to those studies without an adequate breakdown.

2.3.7 Other

Since none of the vaccines involves anything very new with respect to techniques of administration and storage, we assume that no new training is required. Training costs are in any case a relatively small percentage of total costs of vaccination programmes (less than 5% in most of the programmes with cost data). Even if we assumed that training costs were a direct function of the number of vaccines this would add less than $0.10, and generally less than $0.01, to the incremental cost per fully vaccinated child. Costs associated with monitoring and evaluation are assumed to remain constant with the introduction of a new vaccine.

2.3.8 Total incremental costs

Combining the estimates of the costs of additional inputs required for a new vaccine being incorporated into an existing vaccination programme gives the average incremental total costs per child shown in Tables 2.6, 2.7 and 2.8 for measles, rotavirus and cholera vaccines respectively.

Table 2.6. Incremental cost per child fully vaccinated against measles

Country	Incremental cost ($US 1982) by component					
	Local salaries	Central salaries	Vaccines	Other operating	Capital	Total
Brazil (i)	2.56	0.35	0.20	0.08	0.06	3.25
(ii)	0.56	0.11	0.20	0.02	0.04	0.93
(iii)	0.36	0.14	0.20	0.06	0.01	0.77
Cameroon	0.61	0.15	0.20	0.05	0.04	1.05
Gambia	0.64	0.79	0.20	0.16	0.08	1.87
Ghana (i)	7.71	2.63	0.20	0.98	0.49	12.01
(ii)	2.50	0.75	0.20	0.08	0.19	3.72
Indonesia	0.24	0.07	0.20	0.08	0.05	0.64
Ivory (i)	0.31	0.33	0.20	0.00	0.03	0.87
Coast (ii)	1.66	0.42	0.20	0.04	0.02	2.34
Kenya	0.65	0.36	0.20	0.00	0.08	1.29
Philippines	0.72	0.29	0.20	0.04	0.10	1.35
Thailand	1.46	0.58	0.20	0.13	0.15	2.52
Median	0.65	0.35	0.20	0.08	0.06	1.35

Table 2.7. Incremental cost per child fully vaccinated against rotavirus diarrhoea

Country	Incremental cost ($US 1982) by component					
	Local salaries	Central salaries	Vaccines	Other operating	Capital	Total
Brazil (i)	1.44	0.30	0.64	0.27	0.22	2.87
(ii)	0.31	0.09	0.64	0.07	0.15	1.26
(iii)	0.20	0.12	0.64	0.20	0.05	1.21
Cameroon	0.33	0.12	0.64	0.17	0.13	1.39
Gambia	0.37	0.66	0.64	0.53	0.28	2.48
Ghana (i)	4.28	2.20	0.64	3.28	1.64	12.04
(ii)	1.41	0.63	0.64	0.27	0.63	3.58
Indonesia	0.13	0.05	0.64	0.27	0.17	2.13
Ivory (i)	0.17	0.28	0.64	0.00	0.12	1.21
Coast (ii)	0.94	0.35	0.64	0.13	0.07	2.13
Kenya	0.37	0.60	0.64	0.00	0.28	1.89
Philippines	0.40	0.24	0.64	0.13	0.35	1.76
Thailand	0.80	0.47	0.64	0.43	0.52	2.86
Median	0.37	0.30	0.64	0.27	0.22	1.89

Table 2.8. Incremental cost per child fully vaccinated against cholera

Country	Incremental cost ($US 1982) by component					
	Local salaries	Central salaries	Vaccines	Other operating	Capital	Total
Brazil (i)	5.72	0.51	0.64	0.27	0.22	7.36
(ii)	1.24	0.09	0.64	0.07	0.15	2.19
(iii)	0.80	0.20	0.64	0.20	0.05	1.89
Cameroon	1.37	0.22	0.64	0.17	0.13	2.53
Gambia	1.47	1.17	0.64	0.53	0.28	4.09
Ghana (i)	17.20	3.81	0.64	3.28	1.64	26.57
(ii)	5.55	1.08	0.64	0.27	0.63	8.17
Indonesia	0.53	0.10	0.64	0.27	0.17	1.71
Ivory (i)	0.70	0.49	0.64	0.00	0.12	1.95
Coast (ii)	3.71	0.60	0.64	0.13	0.07	5.15
Kenya	1.47	1.52	0.64	0.00	0.28	2.92
Philippines	1.61	0.45	0.64	0.13	0.35	3.18
Thailand	3.25	0.81	0.64	0.43	0.52	5.65
Median	1.47	0.51	0.64	0.27	0.22	3.18

The assumptions described in previous sections, which were designed to determine the highest likely costs, produce estimates of the cost per child fully vaccinated with the new vaccines ranging from $0.64 to $12.01 (median $1.35) for measles; $1.21 to $12.04 (median $1.89) for rotavirus and $1.71 to $26.57 (median $3.18) for cholera.

2.4 Effectiveness estimates

Two recent papers have explored the evidence concerning the effectiveness of measles, rotavirus and cholera vaccines in reducing diarrhoea morbidity and mortality. Feachem and Koblinsky (1983) review data from field studies and employ theoretical calculations to estimate the effectiveness of measles vaccinations. Their results suggest that for a measles vaccine with 85% efficacy, given at an average age of 9 months, 1.4% to 4.2% (say an average of 2.5%) of diarrhoea episodes in children under 5 years of age could be averted by a measles vaccination programme with 100% coverage. (The range is based on various assumptions

concerning the proportion of diarrhoea cases that are measles-associated and the age distribution of measles.) The same programme is estimated to avert between 14.2% and 28.4% (say an average of 20%) of diarrhoea deaths in children under 5 years of age.

De Zoysa and Feachem (1985a) explore the potential of rotavirus and cholera vaccinations. Their results suggest that for a rotavirus vaccine of 80% efficacy and an average age at full vaccination of 6 months, 4% of diarrhoea episodes and 13% of diarrhoea deaths in children under 5 years could be averted by a rotavirus vaccination programme with 100% coverage. For a cholera vaccine of 70% efficacy and an average age at full vaccination of 2 years, 0.21% of diarrhoea episodes and 2.8% of diarrhoea deaths in children under 5 years could be averted by a cholera vaccination programme with 100% coverage in Bangladesh. A recent field trial in Bangladesh of the oral B sub-unit killed whole-cell cholera vaccine indicated that it had a protective efficacy of 85% (Clemens et al. 1986). However, this study measured impact after only six months, and it seems likely that the results from the longer-term evaluations will be less optimistic. For this reason we adopt the more conservative estimate of 70%.

If one assumes an average diarrhoea morbidity of 2.2 episodes per child per year and an average death rate from diarrhoea of 14 per 1000 children per year in children under 5 years (Snyder and Merson 1982), the estimated average number of diarrhoea episodes and diarrhoea deaths averted per year through measles, rotavirus and cholera vaccinations are as shown in Table 2.9. In some least developed countries diarrhoea morbidity and mortality rates are higher than those quoted here and so, correspondingly, would be the number of episodes and deaths averted through these vaccinations.

2.5 Cost-effectiveness estimates

The results of the cost analysis in this paper suggest that measles and rotavirus vaccines could be added to an existing vaccination programme for on average less than $2.00 per CFV with each of those vaccines and that cholera vaccine could be added on average for less than $4.00 per CFV. Applying these costs to estimates of the effectiveness of each of

Table 2.9. Diarrhoea morbidity and mortality averted through vaccinations against measles, rotavirus diarrhoea and cholera

Vaccine	Number of diarrhoea episodes and deaths averted per 1000 vaccinated children per year in children under 5 years of age	
	Episodes averted	Deaths averted
Measles[1]	55.0	2.8
Rotavirus diarrhoea[2]	88.0	1.8
Cholera[3]	4.6	0.4

1. Assuming 85% efficacy of vaccine
2. Assuming 80% efficacy of vaccine
3. Assuming 70% efficacy of vaccine

Table 2.10. Cost per diarrhoea episode and diarrhoea death averted through measles, rotavirus diarrhoea and cholera vaccinations

Vaccine	Cost per diarrhoea episode and death averted in children under 5 years of age[1] ($US 1982)	
	Per episode averted	Per death averted
Measles	7	143
Rotavirus diarrhoea	5	222
Cholera	174	2000

1. Assuming vaccine effectiveness given in Table 2.9 and costs of $2 per measles and per rotavirus diarrhoea vaccination and $4 per cholera vaccination.

these vaccines in reducing diarrhoea morbidity and mortality (see Section 2.4 and Table 2.9) gives the cost-effectiveness estimates shown in Table 2.10. Since the benefits of vaccination in the form of reduced diarrhoea incidence do not all accrue in the same year as vaccination,

there is a case for discounting diarrhoea episodes and deaths averted in years following vaccination. However, the major impact on diarrhoea in children under 5 years of age from measles, rotavirus and cholera vaccines occurs within about two years of vaccination, and discounting therefore makes relatively little difference to the results.

Table 2.10 indicates that the cost-effectiveness of measles and rotavirus vaccines in terms of diarrhoea control are of a similar order of magnitude, with measles vaccination being somewhat more cost-effective than rotavirus with respect to diarrhoea mortality, while rotavirus has the edge in terms of diarrhoea morbidity.

Cholera vaccine is a significantly less viable economic proposition. Even for a country such as Bangladesh, where cholera rates are relatively high, it is estimated to cost $174 per diarrhoea episode averted and $2000 per diarrhoea death averted. These estimates all relate to routinely administered vaccines and not to their use in the case of epidemics, when their cost-effectiveness would probably improve.

2.6 Comments

In assessing the significance of the estimates of cost-effectiveness derived in earlier sections, it is important to consider questions of accuracy and representativeness of both the cost and the effectiveness data. Feachem and Koblinsky (1983) and de Zoysa and Feachem (1985a) discuss in some detail the factors influencing the derivation of the effectiveness data. Here we will focus on costs and consider, in particular, questions relating to the original cost data and the model for deriving incremental costs.

How accurately do the original data reflect the true costs of the programmes? All the studies from which cost data have been gathered employed the WHO guidelines for costing immunisation programmes (WHO 1979) or similar approaches. This costing method attempts to take account of all the resources used in vaccination programmes and value them in a consistent manner, though costs incurred by patients and their families are not included. The studies use market rather than shadow prices which, in the context of many developing countries, may mean that

salaries are overvalued and imports undervalued. Where there were differences in broad approach between the studies, we attempted to reconstruct estimates in a consistent fashion: including the cost of foreign expertise where this was provided; weighting cost averages at health centres by the number of vaccinees; reworking data originally expressed in terms of only one of the vaccines provided in order to reflect the costs of the full schedule (e.g. Ivory Coast and Brazil). In a very few cases, the cost breakdown into input categories was not complete in the original publication and reasonable assumptions were adopted to derive estimates for each category (e.g. Ghana and Brazil).

How typical are the vaccination programmes from which costs have been derived? The costs come from relatively recent studies from low or middle income countries. In terms of types of vaccination schedules, kinds of strategies (mobile/static/mass), population density, levels of existing infrastructure and size of output, the selection appears to encompass a broad range. In addition, the studies are located in a variety of countries whose relative prices of inputs differ. These programmes appear, therefore, to represent a broad range of cost-influencing conditions. There may be some tendency for cost studies to be done on the larger programmes or those involving higher levels of foreign expertise and this may bias the results somewhat.

How reasonable is the model developed for estimating the additional costs of vaccinating a child with the new vaccines, and what are the effects of varying key assumptions? The method used to derive incremental average costs of adding new vaccines to existing schedules employs several assumptions designed specifically to avoid underestimating the likely costs. For example, it is assumed that:

- local level salary costs are directly proportional to dose and contact and that there is no excess capacity and no fixed costs;
- drop-out rates are low (10%);
- a high proportion of central salary costs (50%) are variable with vaccine or dose;
- 50% of local capital costs vary directly with dose.

For each of the three new vaccines, local salary costs contribute significantly to the estimates of the total additional costs of new vaccinations. Furthermore, the method used for calculating incremental local salary costs is the least straightforward. For these reasons, we consider in a little more detail the impact of altering key assumptions used in calculating additional local salary costs.

It has been assumed in our calculations that there is no local staff time which is invariant with respect to doses or contacts. In fact, however, it seems likely that there will be some time required for setting-up equipment, keeping general records, travelling and a share of general upkeep, time which will be relatively constant irrespective of the number of vaccines or doses. Where this constitutes a high proportion of staff time allocated to vaccination (for example, with mobile clinics), and where the inclusion of a new vaccine adds little to this time (for example, where there are no new vaccination sessions), the salary costs of additional vaccines will be overestimated by our assumption that all staff costs are variable. It may be that up to one-third of staff time is spent in this way, which would reduce costs by between 10% and 30% (Table 2.11).

The schedule, dose and route of administration for measles is well established. Rotavirus and cholera vaccines, on the other hand, are still being developed and may not have the characteristics assumed in this paper. Cost estimates for these vaccines are therefore more tentative. We have assumed, for example, that rotavirus vaccine is administered in doses separate from OPV. If the two were combined in the same dose, a possibility currently being considered, this could make a significant difference to costs. The vaccine itself is likely to be the only major additional cost, reducing cost estimates by about a half.

The assumptions we have adopted for other variables in our model (namely, the relative amount of time spent on oral versus injected doses and on new contacts, and the rate of drop-outs) influence two stages of the calculations: the estimate of cost per IDE derived from each vaccination programme for which there are available cost data; and the estimate of the number of IDEs required to fully vaccinate with each of the new vaccines. These effects tend to work in such a way that the net

impact on cost estimates of changing the assumptions is relatively small. For example, if we assume a higher drop-out rate, the overall number of doses and IDEs that have been used in an existing programm per child that has been fully vaccinated by that programme will be greater than the estimates we have given, and the cost per IDE consequently smaller. On the other hand, for a new vaccine involving new contacts, this higher assumed drop-out rate will imply that more IDEs are required to fully vaccinate with that vaccine. In other words, choosing a high drop-out rate will tend to make the estimated cost per IDE in the existing programme low, but the number of IDEs per child fully vaccinated with the new vaccine, high. The net direction of the impact will depend on the relationship between the number of new contacts in the original schedule and the number required for the new vaccine. Similar explanations apply to the results of changing assumptions concerning the relative time required for new contacts or for oral versus injected doses.

Table 2.11 illustrates how the median estimates of cost per child vaccinated with each new vaccine change as various assumptions are altered. On the whole, the estimates we have derived appear to be reasonably robust, and the cost-effectiveness ordering of the vaccines is not altered by those changes in the assumptions which we explore in Table 2.11.

The results from the analysis in this chapter suggest that cholera is likely to be the most expensive new vaccine to introduce, being of the order of twice as expensive as rotavirus or measles. This difference may be greater if, for example, the cholera vaccine itself proves to be more expensive than the other vaccines (perhaps because of the need to administer a gastric acid buffer prior to vaccination), or if drop-out rates for cholera are higher than for other vaccines. On the other hand, some assumptions in the paper have the effect of inflating the difference. Local staff costs, which comprise roughly 50% of total costs, largely account for the difference between cholera and the other vaccines. If a proportion of local staff costs are in fact fixed with respect to doses or contacts, the costs of adding measles, rotavirus and cholera vaccines may be more similar than we suggest.

Table 2.11. The effect of changes in assumptions on estimates of cost per child vaccinated

Assumption set[2]	Incremental cost per CFV[1] ($US 1982)		
	Measles	Rotavirus	Cholera
A	1.35 (0.64-12.01)	1.89 (1.21-12.04)	3.18 (1.71-26.57)
B	1.50 (0.70-12.60)	1.50 (1.00-9.20)	4.10 (2.00-33.90)
C	1.30 (0.60-10.20)	1.80 (1.20-11.50)	3.30 (1.70-24.40)
D	1.35 (0.65-10.90)	2.60 (1.40-18.80)	4.00 (1.90-31.40)
E	1.10 (0.60-9.50)	1.70 (1.10-10.60)	2.50 (1.50-21.00)

1. Median (and range) derived from the 13 projects in Table 2.2.

2. Assumptions adopted are as follows:

   A - contact time = 1 IDE; drop-out rate = 10%;
   oral dose time = 1/3 IDE;
   local staff time is variable with dose and contact.
   B - as for A except that contact time = 5 IDE.
   C - as for A except that drop-out rate = 20%
   D - as for A except that oral dose time = 1 IDE
   E - as for A except that 1/3 of local staff time is fixed.

The conclusion that cholera may not cost very much more than other vaccines runs counter to intuition: vaccinating a child who would otherwise probably not attend the clinic must involve considerably more effort and hence cost. Indeed this is the case, but the bulk of this cost is borne by the family rather than the health facility, and the consequences are likely to be reflected in impact rather than cost measures - attendance and coverage are likely to be lower. There are, however, some possible cost implications of this reduced coverage. Firstly, to the extent that economies of scale operate with respect to the new vaccine, average incremental costs will be greater when attendance is lower. But incremental costs fixed with respect to dose are low, so this effect is not expected to be very great. Secondly,

some trade-off between costs and coverage is possible: incentives or penalties to induce mothers to bring their children for vaccination can be provided (e.g. legislation requiring school entrants to be vaccinated); increased outreach facilities can be established to reduce the cost to mothers of bringing their children for vaccination; extra publicity can be mounted to change the mothers' demand for vaccination. Estimating the costs of these options is not easy. The extensive publicity for Brazil's polio mass campaign was calculated to be of the order of 15% of total campaign costs - or about $0.30 per child vaccinated against polio. If similar costs were incurred for cholera this would increase costs by about 10%.

Debate concerning the relative cost of cholera vaccinations compared with measles and rotavirus assumes less significance when it is appreciated that the relatively poor performance of cholera vaccine in cost-effectiveness terms is substantially attributable to its lower effectiveness in reducing diarrhoea incidence rather than to its costs. Even in Bangladesh, cholera constitutes a relatively small proportion of total diarrhoea cases. Even if cholera vaccination were comparable in cost to measles or rotavirus vaccination, cost per diarrhoea episode or death averted would be about five times higher for cholera.

III BREAST-FEEDING PROMOTION

3.1 Background

The association between failure to breast-feed and diarrhoea incidence and severity has been convincingly demonstrated, as has the possibility of influencing breast-feeding rates through various strategies (Feachem and Koblinsky 1984).

The duration of breast-feeding is associated with many factors. Some (for example levels of urbanisation, education and income) can reasonably be assumed to be beyond the scope of policy-makers concerned with diarrhoeal diseases. Others are more amenable to intervention. The principal factors influencing breast-feeding (and through which education, urbanisation and income variables are mediated) can conveniently be grouped into four categories (Huffman 1984):

- sociocultural environment;
- health care services;
- mothers' pattern of work;
- knowledge and availabilty of breast-milk substitutes.

On the basis of an understanding of these factors and an appreciation of the feasibility of intervention, it is possible to identify several strategies which would be expected to increase breast-feeding rates. In this paper we consider five important strategies, while recognising that some possibilities are omitted: education of school children and encouragement of breast-feeding groups, for example. The strategies are:

- changes in hospital routine;
- face-to-face education and support;
- mass media promotion;
- legislation against the use of breast-milk substitutes;
- provision of facilities for working women.

In the following sections we take each strategy and explore its cost implications and note evidence concerning the impact on breast-feeding. There are few cost data available and it has been necessary to develop

for each strategy a plausible model of the nature and scope of inputs and prices. The resulting estimates are rough; their limitations and the need for further research is discussed in Section 3.8. The prices used are based on the results of a small informal survey conducted at the London School of Hygiene and Tropical Medicine in which a questionnaire addressed to students on the MSc Community Health in Developing Countries course, all of whom are experienced health professionals with detailed knowledge of at least one developing country.

Rather than calculate separate cost-effectiveness estimates for each strategy, we consider the range of cost-effectiveness estimates for a plausible promotional package (Section 3.7). We do this for three reasons. Firstly, the effectiveness data, particularly for some strategies, are inadequate and frequently come from projects which involve more than one strategy. Secondly, there are significant differences between the strategies not captured by measures of monetary costs and impact on breast-feeding. In some strategies (e.g. legislation) the non-monetary costs and additional benefits may be large and politically important and therefore a major consideration in making choices between strategies. Finally, the principal concern of this chapter is not so much to select a particular strategy as to determine how breast-feeding promotion compares with other broad types of intervention as an approach to diarrhoea control.

3.2 Strategy 1: Changes in hospital routine

3.2.1 Description of strategy

One of the strategies most carefully studied for its impact on breast-feeding is changes in hospital routine. Several kinds of changes have been demonstrated to increase breast-feeding rates including:

- providing facilities for "rooming-in" - where neonates are kept in the same room as the mother (Bjerre and Ekelund 1970);
- encouraging skin-to-skin contact and early breast-feeding after delivery (Klaus and Kennell 1976);
- allowing demand feeding and limiting supplementary feeding (Olmstead and Jackson 1950);

- stopping the practice of weighing before and after breast-feeding (de Chateau et al. 1977);
- encouraging the ingestion of colostrum (Mata et al. 1982);
- using drugs cautiously (Applebaum 1975);
- prohibiting distribution of free samples of infant formulae to mothers in hospital (Bergevin et al. 1983).

Additional resources required to implement these strategies appear to be minimal. In a study which involved the initiation of compulsory rooming-in McBryde (1951) notes: "No special equipment was required... no special modifications of rooms or wards was needed." Indeed it was observed that "cost per patient decreased since the mother is ambulatory after 24 hours and aids in the care of the child".

However, in order to facilitate the introduction of new routines it is necessary to convince staff of their appropriateness and this may require resources. McBryde (1951) makes it quite explicit: "One year was required to persuade the staff that rooming in was desirable." (Even then it took "lurid newspaper accounts of a nursery epidemic of infectious diarrhoea" finally to overcome staff resistance.)

None of the effectiveness studies describes in any detail the process involved in preparing an institution for a change in routine. Hales (1981), however, outlines a model for planned change and explores its relevance to changing hospital policy with respect to breast-feeding. A real-life example of attempting to institutionalise rooming-in is used to illustrate the model. This effort required the time of a change agent who, after identifying the nature of the existing system, enlisted support and lobbied the chief of paediatrics. A neonatologist assisted in providing seminars and support for nurses. A trial of rooming-in was conducted. "The process took more than one year and many meetings and involved changing maternity visiting hours" (Hales 1981).

An alternative approach to promoting changes in hospital routine, and one which could be more easily achieved through outside intervention, is to hold a national conference on the subject of breast-feeding and its advantages, and hospital arrangements which facilitate it. The conference would be conducted for key decision-making personnel in each

hospital in the country or region in order to influence them to change hospital procedures. Durongdej and Israel (1986) describe a successful project of this sort in Thailand involving a one week national workshop for key professionals from several hospitals. Each hospital was invited to send a paediatrician, an obstetrician, a paediatric nurse and an obstetric nurse who were encouraged to serve as "lactation management trainers" for all colleagues who did not attend. At the end of the workshop each group prepared plans to encourage breast-feeding in its own hospital and these were presented to the workshop in a final session to which administrators from each hospital were invited.

3.2.2 Cost estimates

Costs involved in changing hospital routine or comparable exercises have not been located. To develop a rough estimate of likely costs we propose a model of the resources that may be required to lobby for change within the hospital or through a conference, and value these. We assume that for the period of one year a change agent within the organisation (possibly a trainee doctor) spends one day a week on lobbying and related activities, that meetings involving the paediatrician, obstetrician and head nurse occur once a month for half a day and that a visiting advisor spends a total of two days giving seminars and doing ward rounds. This seems reasonable for a large hospital and we assume that the same effort is required irrespective of hospital size. After the change in routine is established no further costs are involved. Given 240 working days per year and annual wages of the staff as shown in footnote 1 to Table 3.1, the total cost of the activity per hospital is about $1700.

For promotion through a conference, we assume a one-week conference/workshop involving four weeks' full-time preparation and follow-up by a medical officer, two weeks' secretarial assistance and attendance by 40 participants from 10 hospitals. This would cost nearly $19 000 using the assumptions detailed in footnote 2 to Table 3.1. With each hospital represented by four people, the cost per hospital would be about $1900.

Table 3.1. Cost per delivery of changes in hospital routine (all costs in $US 1982)

Hospital size (deliveries per year)	Costs			Present value of the no. of deliveries over 5 years[3]	Cost per delivery	
	Lobby[1]	Conf[2]	Lobby + conf		Conf	Conf + lobby
500	1 705	1 862	3 567	2 085	0.89	1.71
1 000	1 705	1 862	3 567	4 170	0.44	0.86
5 000	1 705	1 862	3 567	20 850	0.09	0.17
10 000	1 705	1 862	3 567	41 700	0.04	0.09
20 000	1 705	1 862	3 567	83 400	0.02	0.04

1. Lobbying per hospital:

Cost item	Number	Annual salary	Time (proportion of days per year)	Total cost
Change agent	1	5 000	48/240	1 000
Paediatrician	1	10 000	6/240	250
Obstetrician	1	10 000	6/240	250
Head nurse	1	5 000	6/240	125
Visiting advisor	1	10 000	2/240	80
Total				1 705

2. Conference for 10 hospitals:

Cost item	Number	Annual salary	Time (proportion of days per year)	Total cost
Medical officer	2	10 000	20/240	1 667
Secretary	1	3 000	10/240	125
Participants:				
salary	40	10 000	5/240	8 333
per diem/travel	40	200		8 000
Stationery, hall Hire, etc.				500
Total				18 625

3. The present value of the number of deliveries over life of hospital = $\sum_{n=0}^{y-1} \frac{Z}{(1+r)^n}$ where z = number of deliveries per year, r = discount rate (here 10%), y = number of years (here 5 years, see text)

The change in hospital routine resulting from either or both approaches will be experienced by all women giving birth during the period that the hospital functions after the new routine is introduced, which could be 20 or 30 years or more. However, because it is difficult to predict the relationship between hospital routine and breast-feeding rates far into the future, we focus here on the first five years only. Table 3.1 presents the estimates of the cost per delivery of changing hospital routine through the conference or the conference plus lobbying approach for hospitals of different sizes. The cost per delivery ranges from about $0.01 in 20 000 delivery per year hospitals for the conference only, to over $1.00 in small 500 delivery hospitals where a conference and lobbying were required. If the impact of the change was measured over 15 years instead of five, the costs per delivery would be halved.

3.2.3 Effectiveness estimates

There is a substantial literature documenting the impact on breast-feeding of changes in hospital routine (Winikoff and Baer 1980). Several studies have shown that encouraging immediate breast-feeding and skin-to-skin contact can increase the duration of breast-feeding (Klaus and Kennell 1976; de Chateau et al. 1977) and breast-feeding rates (Johnson 1976). Rooming-in has been found to increase the rates of breast-feeding measured both at discharge (Bjerre and Ekelund 1970; McBryde 1951) and later (Sousa et al. 1974). On-demand feeding and careful use of drugs can increase rates of breast-feeding (Olmstead and Jackson 1950). Based on four studies providing data on breast-feeding rates by age, changes in hospital routine were found to result in a median reduction in the proportion of non-breast-fed babies less than 3 months old of 70% (Bjerre and Ekelund 1970; McBryde 1951; Johnson 1976; Sousa et al. 1974).

That activities such as a conference can promote changes in hospital routine has been demonstrated. The national lactation workshop for hospital staff in Thailand, for example, resulted in important changes in routine in all hospitals participating and these changes gave rise to increased knowledge about breast-feeding among mothers (Durongdej and Israel 1986).

3.3 Strategy 2: Face-to-face education and support

3.3.1 Description of strategy

Face-to-face education to promote breast-feeding is commonly directed either at mothers or at mothers-to-be though occasionally at others (for example fathers (de Chateau et al. 1977)). Various venues for breast-feeding promotion have been used. Women attending well-baby or immunisation clinics may receive messages concerning breast-feeding. Mothers can be visited individually in their homes or in community groups. The effectiveness of these, however, has not been demonstrated. In this section we concentrate on one approach which has been shown to have an impact on breast-feeding rates - the provision of information and support to women in hospital for childbirth. (The potential for education in health centres is discussed in more detail in Chapter 5.) All the studies from which effectiveness data on this strategy were derived were centred in hospitals, though a few involved some additional information and support provided when the women had returned home after delivery (e.g. Mata et al. 1982; Hardy et al. 1982; Jepson et al. 1976).

Not all the programmes whose effectiveness has been studied lend themselves to replication. For example, Burne (1976), in a study in Oxford, UK, attributes higher breast-feeding rates to a stable and familiar health team providing continued care; Kirk (1978) identifies the publication of the DHSS Report "Present Day Practices in Infant Feeding" as a key factor promoting breast-feeding in the UK. Here we will focus on repeatable educational programmes provided to health staff and to mothers hospitalised for childbirth.

Unfortunately, most studies provide minimal information on the nature of the intervention. For example, Jepson et al. (1976) simply note that a working party was established which aimed to promote breast-feeding in Sheffield, UK, by, inter alia, education of doctors and nurses on the advantages and management of breast-feeding. Coles and Valman (1976) describe their intervention in Harrow, UK, as "an educational programme, including the making of a film". Discussions on the merits of continued breast-feeding with the area health visitors and midwives is the extent of the explanation for increased breast-feeding in Oxford, UK (Sloper

et al. 1977). Three studies (Brindlecombe and Cullen 1977; Sloper et al. 1975; Hardy et al. 1982) provide more information, though none give sufficient details to allow specific costings and none attempt to cost their own strategies.

Education of hopital staff

Two common elements in efforts to promote breast-feeding through education of hospital staff appear to be a seminar for nurses and a survey (initiated before the seminar and used as a basis for discussion) of breast-feeding rates of mothers leaving hospital. A single seminar has generally been considered adequate, though this probably applies only where there is a continued atmosphere of interest created by senior staff. For example, Brindlecombe and Cullen (1977) note that the strategy worked best in the place where the organisers were located. A survey of breast-feeding practices was an essential design feature of all those studies measuring changes in breast-feeding rates. Their primary purpose was evaluation, but in many cases they also became an important source of information and motivation for staff. In fact, the intervention described by Smart and Bamford (1976) initially involved only a survey and it is to this that the changes in breast-feeding rates are cautiously attributed. "There may have been an effect of merely showing an interest in breast-feeding. The initial survey and proposal of research on breast-feeding led to a lot of discussion and was attended by hospital staff, community midwives and health visitors." It seems likely that both the interest generated by the implementation of the survey itself and the impact of the findings could contribute to a survey's success in changing the attitudes and behaviour of staff. How substantial or thorough such a survey needs to be before it becomes effective as an educational tool is not clear. Even a relatively small-scale investigation may be useful, as long as it is sufficiently sensitive to monitor improvements and demonstrate to the satisfaction of the health workers that breast-feeding levels are undesirably low.

Education of mothers

The direct education of mothers in hospital usually takes the form of a lecture plus discussion presented by a nurse or paediatrician and

involving the use of visual aids such as a short film or slides and tapes. While in some ways similar exercises, which may even involve the same educational materials, education of mothers and education of hospital staff are rather different in their cost implications. The former involves essentially a one-off exercise with possible supplementary refresher courses for the period that the same staff remain at the hospital. Education of mothers in hospital for childbirth by contrast, requires continued investment for each new group of women coming in for delivery.

3.3.2 Cost estimates

For the education of hospital staff, we assume that one nurse is occupied for 12 weeks full-time in the preparation, implementation and assessment of a survey on breast-feeding, that a paediatrician or equivalent spends a week in the preparation and presentation of seminars and tests, that each nurse spends half a day at the seminar, and that stationery, visual aids and other materials worth $250 are used for the survey and seminar. The total cost and the costs per delivery of educating hospital staff are shown in Table 3.2; and the latter range from $0.05 for large hospitals to $1.35 for hospitals with 500 deliveries per year. The costs are not much affected by the number of nurses trained: the bulk of the costs are fixed. The size of the hospital therefore makes a large difference to cost per delivery though this effect is probably exaggerated by the assumption that the time involved in the initial survey would be the same for each hospital. A crucial determinant of cost per delivery is the length of time for which the training of the nurses influences breast-feeding behaviour. We are assuming that the impact of the training would last about two years, after which training of new nurses or refresher training for those who continued to work would be required. If the effects were to last for five years, the costs per delivery would be halved.

For the direct education of mothers in hospital for childbirth, we assume that one nurse is trained for two weeks to educate mothers and employs visual aids and equipment costing $200; we assume also that the nurse discusses breast-feeding for half a day with each group of women, and that each group has between five and twenty women. (In the smaller

Table 3.2. Cost per delivery of educating hospital staff about breast-feeding and how to support and inform mothers

Hospital size (del'ies per year)	No. of nurses trained[1]	No. of clas -ses[2]	Costs ($US 1982) Fixed[3]	Variable[4]	Total	Present value of no. of del'ies by trained staff[5]	Cost per delivery ($US 1982)
500	10	1	1 208	83	1 291	955	1.35
	2	1	1 208	33	1 241	955	1.30
1 000	20	1	1 208	146	1 354	1 910	0.70
	5	1	1 208	52	1 260	1 910	0.66
5 000	100	4	1 208	708	1 916	9 550	0.20
	25	1	1 208	177	1 385	9 550	0.14
10 000	200	8	1 208	1 417	2 625	19 100	0.14
	50	2	1 208	354	1 562	19 100	0.08
20 000	400	16	1 208	2 833	4 041	38 200	0.10
	100	4	1 208	708	1 916	38 200	0.05

1. Assuming the number of deliveries per nurse per year ranges between 50 and 200.
2. Assuming a maximum class size of 25 nurses.
3. Assuming 1 nurse (on $3000 per year) spends 60 working days in preparing and implementing a breast-feeding survey; a paediatrician (on $10 000 p.a.) spends five days preparing material for seminars for nurses; and teaching and survey materials worth $250 are used.

   (60/240 x 3000 + 5/240 x 10 000 + 250 = 1208).

4. Assuming nurses (on $3000 per year) spend half a day in a seminar (i.e. 0.5/240 x 3000 = $6.25 per nurse) and a paediatrician spends half a day with each class (i.e. 0.5/240 x 10 000 = $20.83 per class).
5. Present value of number of deliveries supervised by trained staff. Assuming the effects of the training last two years and that the discount rate (r) is 10%, the present value multiplier is:

$$\sum_{n=0}^{1} \left(\frac{1}{1+r}\right)^n = 1.91$$

hospitals, with 500 deliveries per year, even if women stay on average three days in hospital for delivery there will not be more than about five women at any one time.) The cost of this activity is derived in Table 3.3. Most of the costs are variable at least for the larger

Table 3.3. Cost per delivery of directly educating mothers in hospital

Hospital size (del'ies per year)	No. of mothers per lecture	No. of nurses trained[1]	Costs ($US 1982) Fixed[2]	Costs ($US 1982) Variable[3] per year	Cost per delivery 1 year programme	Cost per delivery 5 year programme[4]
500	2	1	365	1 562	3.85	3.30
	5	1	365	625	1.98	1.42
1 000	5	1	365	1 250	1.61	1.38
	10	1	365	625	0.99	0.71
5 000	5	3	1 095	6 250	1.47	1.30
	20	1	365	1 562	0.38	0.33
10 000	5	5	1 825	12 500	1.43	1.29
	20	2	730	3 125	0.39	0.33
20 000	5	9	3 285	25 000	1.41	1.29
	20	2	730	6 250	0.35	0.32

1. Assuming that one nurse can cope with a maximum of 480 training sessions a year (i.e. 2 sessions per day for 240 days).
2. Assuming each nurse educator receives 10 days training from a trainer (on $10 000 per year) in a group of 10 nurses, and employs visual aids worth $200 for educating mothers.

   (10/240 x 3000) + (10/240 x 10 000/10) + 200 = $365 per nurse

3. Assuming each nurse educator spends half a day with each group of mothers.

   0.5/240 x 3000 = $6.25 per education session

   The number of sessions equals the number of deliveries divided by the size of the group of mothers lectured.
4. Discounting variable costs and future deliveries by 10% per year.

hospitals with smaller groups of mothers. The costs have been calculated assuming that the programme runs for one year or five years. Because a high proportion of costs are variable, the period for which the programme runs makes relatively little difference to cost per delivery. The major determinant of costs is the size of the group of mothers. Costs of education per delivery are under $1.00 where groups of 10 or more mothers are educated. For smaller groups of five or less,

the costs are between $1.41 and $3.85 per delivery for a one-year programme.

3.3.3 Effectiveness estimates

Education of health personnel is documented to have an important impact on breast-feeding rates. The median reduction in the proportion of non-breast-fed infants upon hospital discharge was 24% (range: 11% to 35%), based on five studies from England (Brindlecombe and Cullen 1977; Creery 1973; Sloper et al. 1975; Sloper et al. 1977 and Smart and Bamford 1976). Evidence concerning the success of education provided directly to mothers is more limited: Coles and Valman (1976) found, at the time of hospital discharge, a reduction in the proportion of non-breast-fed babies of 32%; de Chateau et al. (1977) found that information to mothers had little impact; Rawlins claimed a 48% fall in the proportion of non-breast-fed children at discharge as a result of obstetric counselling and group support (reported in Winikoff and Baer 1980). Education of both mothers and health staff, reported in Hardy et al. (1982), resulted in a median reduction in the proportion of non breast-feeding of 31% for infants under 3 months. Interventions involving a combination of the provision of information and support to mothers and changes in hospital routine achieved an average reduction in the proportion of non-breast-fed infants under 3 months of about 40% based on studies from England (Jepson et al. 1976), Czechoslovakia (Svejcar 1977) and Singapore (Wong 1975). It is not clear why the combined impact of changes in hospital routine and hospital-based education is smaller than that of changes in hospital routines alone (see Section 3.2.3), but it may be that different aspects of hospital routine were changed. The number of studies is in any case small and the difference in mean values not statistically significant at the 5% level.

3.4 Strategy 3: Mass media

3.4.1 Description of strategy

It is not at all clear in theory what would comprise an appropriate mass media package for promoting breast-feeding. The relative effectiveness of alternative mass media approaches has not been convincingly

demonstrated. This uncertainty is to some extent reflected in the range of designs of mass media health promotion activities observed in practice. Some have been quite low-key and conventionally educational, such as Kenya's weekly 15 minute radio serial on "Giving Birth and Caring for Your Baby" (Jamison and McAnany 1978). Others, such as the Philippines' campaign to improve weaning practices, have employed the intensive "reach and frequency" advertising technique involving the regular broadcasting of short spots with the same simple message (Leslie 1980). In many cases printed materials accompany radio broadcasts. The Tanzanian "Man is Health" programme involved the organisation of regular discussion groups which used written materials as an essential component of health promotion based on radio broadcasts (Hall and Dodds 1977). Brazil's breast-feeding promotion campaign included an intensive mass media effort over 45 days with messages carried by nearly 100 television stations and 600 radio stations, press advertisements and messages on lottery tickets, telephone/electricity/water bills and bank statements all over the country (Matthai 1983).

In general, in developing countries, low rates of television ownership and literacy argue against the use of television and newspapers and in favour of radio and posters, though evaluations have not been able to demonstrate much impact from printed materials (Gatherer et al. 1979). Beyond identifying appropriate media, the literature offers very little practical guidance on what might constitute an appropriate strategy: how many radio hours, broadcast how often, over what period?

3.4.2 Cost estimates

A number of countries have embarked on national campaigns to promote breast-feeding using mass media (e.g. Brazil, Colombia, Jamaica, Mexico, Papua New Guinea, Sweden and Thailand). Despite this experience, useful cost data on mass media, particularly in relation to breast-feeding, are not easy to locate. Ideally what is required are ranges of costs per mother who breast-feeds when she otherwise would not, or costs per mother exposed to media together with effectiveness data relating exposure to increases in breast-feeding rates. Neither set of information is readily available. Even deriving cost estimates from information on inputs is difficult since evidence is fragmentary. We

determine a plausible range of possible costs by looking at examples of costs of mass media education campaigns.

The potential range of costs in mounting a breast-feeding promotion campaign using mass media is vast, and not only because the choices concerning the intensity and length of the campaign and ways of packaging the components are essentially limitless. The costs of the components can also vary substantially. For example, production costs of television may vary from $175 per hour for a simple recording of a teacher's lecture to over $50 000 per hour for more sophisticated programmes using professional standards (Eicher et al. 1982). Radio programmes are cheaper, but still vary considerably. Jamison and McAnany (1978) quote costs ranging from $700 to $2000 per hour. Transmission costs also exhibit considerable variation between countries, between stations within countries and between time slots for the same station (Jamison and McAnany 1978). In many cases no charges are made for broadcasting programmes such as those promoting breast-feeding, either because the law provides for a right to air-time on commercial networks (e.g. in Brazil) or because the national station is a public service that makes its network available for instructional programmes (e.g. in the Philippines). Sometimes commercial stations can be persuaded to provide free air-time voluntarily, although there is the danger that without payment radio stations are not motivated to broadcast messages, and exposure and impact are consequently low (Zeitlin et al. 1984).

Total costs of mass media health promotion activities have ranged from those which have cost less than $20 000 (such as the Kenya programme on child care) and usually involve local staff and cheaply produced radio programmes, to those costing over $500 000, where foreign expertise is used and audience research undertaken to produce high quality radio and television programmes, broadcast at peak times and accompanied by printed publicity. For example, the Tanzanian "Man is Health" programme was estimated to cost $610 000 (Hall and Dodds 1977) and the Brazilian breast-feeding mass media campaign over $3 million (Matthai 1983). Between these lie programmes such as the Honduran and Gambian ORT promotion exercises, where annual costs were estimated to be between $30 000 and $60 000 (Shepard and Brenzel 1985).

We consider the cost implications of a range of possible types of promotional campaigns drawing on data presented above:

Type A - a basic campaign restricted to radio, costing $20 000;

Type B - a more intensive and sophisticated effort, perhaps using foreign expertise, costing $100 000;

Type C - a combination of type B with printed materials, one poster per 100 population at $0.75 per poster;

Type D - a luxury model, involving intensive use of a wide range of media including television together with printed materials, costing $500 000 plus one poster per 100 population at $0.75 per poster;

Type E - the same as type D, but with printed materials costing five times more per head.

The total costs of programmes of those five types for different population sizes are shown in Table 3.4. Using these data, together with numbers of mothers exposed to mass media under different assumptions of coverage, the costs of breast-feeding promotion per mother exposed to mass media are derived (Table 3.5). The analysis considers a range of possible total population sizes in the area covered by a mass media breast-feeding campaign, and assumes that the target group is mothers with children born in the year of the campaign. The proportion of the target population which is exposed to the media will depend on several factors including access to the media and the likelihood of receiving the message from the media (which is itself a function of, inter alia, the popularity of the media, and the time-slot and quality of the broadcasts). We explore the consequences of two values for coverage, a high one of 80% and a relatively low one of 20%. The analysis shows that:

- costs per mother exposed range from $0.01 for cheaper promotional programmes in large populations with high coverage, to nearly $130 using luxury programmes in small populations with low coverage;
- it is difficult to achieve costs below $1.00 per mother exposed unless populations of more than 1 million are being served;
- "luxury" promotions can be conducted in populations of more than 10 million for less than $11 per mother exposed, and for less than $1.50 in populations greater than 50 million with high coverage.

Table 3.4. Derivation of total costs of breast-feeding promotion through mass media for different sized populations

Promotional package			Total cost of mass media breast-feeding promotion ($US 1982)			
Type[1]	Costs		Total population (TP)			
	Fixed	Variable[2]	500 000	1 million	10 million	50 million
A	20 000		20 000	20 000	20 000	20 000
B	100 000		100 000	100 000	100 000	100 000
C	100 000	+ 0.0075TP	103 750	107 500	175 000	475 000
D	500 000	+ 0.0075TP	503 570	507 500	575 000	875 000
E	500 000	+ 0.0375TP	518 750	537 500	875 000	2375 000

1. See Section 3.4.2 of the text.
2. TP = total population.

Table 3.5. Cost of breast-feeding promotion per mother exposed to mass media by promotion package type, population size and coverage

Total population[1] (& mothers exposed)[2] (both in 1000s)	Cost per mother exposed ($US 1982)				
	Promotional package type[3]				
	A	B	C	D	E
High coverage - 80%					
500 (16)	1.25	6.25	6.48	31.48	32.42
1 000 (32)	0.62	3.12	3.36	15.86	16.80
10 000 (320)	0.06	0.31	0.55	1.80	2.73
50 000 (1600)	0.01	0.06	0.30	0.55	1.48
Low coverage - 20%					
500 (4)	5.00	25.00	25.94	125.94	129.69
1 000 (8)	2.50	12.50	13.44	63.44	67.19
10 000 (80)	6.25	1.25	2.19	7.19	10.94
50 000 (400)	0.05	0.25	1.19	2.19	5.94

1. The number of people in the area covered by the promotional programme.
2. The number of mothers of children born in the year of the programme assuming an annual birth rate of 4 per 100, and either high (80%) or low (20%) exposure to the message.
3. See Section 3.4.2 of text.

There is little point in attempting to do more than identify likely orders of magnitude of costs for several reasons. Firstly, the possible variations in quality and scale (and hence costs) are large. Secondly, these differences are difficult to correlate with effectiveness: "Using professional criteria to judge productions it is possible to find a close relation between the unit costs of different programmes and their technical quality. But the relation between the cost and/or the technical quality of these educational programmes and their pedagogical impact is much less close" (McAnany et al. 1983). Thirdly, cost-effectiveness is likely to vary roughly in proportion to the size of the educational target group exposed to the message: effectiveness will increase with audience size while most production and transmission costs remain fixed. The range of potential audience size is very large and probably accounts for more of the possible variation in average costs than differences in the likely total costs of the mass media promotion exercise.

3.4.3 Effectiveness estimates

The use of mass media to promote breast-feeding is a relatively recent development and its effectiveness in changing breast-feeding rates is not well documented. Indeed, published data on the impact of mass media projects on health behaviour in general is scanty. Leslie (1980) summarised the evidence to that time from a review of 15 mass media health and nutrition projects in developing countries as follows:

- mass media health and nutrition projects can reach large numbers of people (up to several million) in a relatively short time;
- between 10% and 50% of those reached remember the message of the programme at least during or immediately after the project;
- there is some evidence that people will adopt new health-related behaviours;
- there is no evidence concerning long-term retention of knowledge gained from mass media health projects and no evidence concerning the impact of such projects on health status.

Recent studies have encouraged educationalists to be more sanguine about the potential of mass media to change health habits. They have confirmed that audiences exposed to mass media health campaigns can

adopt new behaviours at high rates (e.g. the ORT promotional projects in The Gambia (Foote et al. 1985) and Honduras (Pinto and Storey 1985)) and that these can have a measurable impact on health status. Diarrhoea mortality in Honduras declined over the period of an intensive ORT promotional campaign which included a substantial mass media component (Pinto and Storey 1985).

Data on the effectiveness of mass media promotion on breast-feeding are largely restricted to measurements of access to media and retention of key messages, rather than behavioural changes. Changes in breast-feeding rates were recorded following the Swedish breast-feeding promotion campaign which included the use of mass media: a decrease of about 57% in the proportion of non-breast-fed children under 3 months over the period 1972-1974 (Sjolin 1976). This programme, however, included a number of elements other than mass media, such as the education of key health personnel and changes in hospital routine.

3.5 Strategy 4: Discouragement of breast-feeding alternatives

3.5.1 Description of strategy

There is evidence that the marketing of infant formula has had an impact on the choice and duration of infant feeding practices (e.g. Greiner and Latham 1982). To counter these effects, a number of countries have intervened to regulate the promotion of infant feeds. The International Code on the Marketing of Breast-milk Substitutes, approved by the World Health Assembly in May 1981, recommends a number of ways to regulate promotion including:

- restrictions on advertising;
- restrictions on the distribution of free samples;
- requirements for the proper labelling of infant feeds.

Some countries have taken more drastic steps. For example, Ghana and Jamaica have restricted the import of infant formula; Guinea Bissau and Papua New Guinea have enacted legislation requiring that formula and bottles are sold only in pharmacies on a doctor's prescription; and Algeria has nationalised the import of all infant formula (Baer 1981).

3.5.2 Cost estimates

Costs to the implementors of legislation will include the cost of manpower necessary for drafting, promulgating and policing legislation and prosecuting offenders. Insufficient data on the costs of establishing and policing legislation in developing countries are available to allow any accurate cost estimates to be derived. The costs are difficult to measure and may be relatively small in circumstances where efficient legislative and policing machinery exists already. On the other hand, the possible scale of the costs should not be underestimated. It may require the services of a lawyer for a year (at, say, $10 000 per year) to draft the legislation and promulgate it. It would not be difficult for publicity and legal costs in the first year to run to $50 000. Maintenance costs after legislation are likely to be considerably smaller, say $10 000 per year for "watch-dog" operations (in the form of employment of a lawyer). Costs per child born at a time when the mother is exposed to the intervention will depend on the size of the population and the period over which the legislation is effective. Table 3.6 explores some possibilities and suggests that costs per child may vary from less than $0.01 to about $3.00.

Table 3.6. Cost of breast-milk substitute legislation per child born during the period for which the legislation is effective

Period for which the legislation is effective	Total[1] cost ($US 1982)	Cost per child ($US 1982)[2]			
		Population size (target population)[3]			
		500 000	1 million	10 million	50 million
1 year	60 000	3.00	1.50	0.15	0.03
5 years	90 950	1.11	0.55	0.06	0.01
10 years	115 130	0.89	0.44	0.04	0.01

1. Assuming a fixed cost of $50 000 and annual "policing" costs of $10 000 per year and discounting the value of future costs by 10% per year.
2. Discounting benefits (children born during the period that legislation is effective) by 10% per year.
3. Assuming an annual birth rate of 4 per 100.

3.5.3 Effectiveness estimates

There are few data on the effectiveness of legislation and regulations concerning breast-milk substitutes. It is in general difficult to predict the impact of such regulations since the market tends to make various adjustments when artificial constraints are imposed. There are several reasons why legislation may not be successful (Post et al. 1984). Industries may adopt other practices against the spirit but not the letter of the law, such as increased price competition, as observed in Thailand and Indonesia, or the redirection of promotional efforts away from the consumer towards health workers. Manufacturers may simply ignore the code and continue, for example, to provide pregnant women with samples of breast-milk substitutes. Nevertheless, some successful cases can be cited: in Port Moresby, Papua New Guinea, for example, prevalence rates of non breast-feeding among children less than 2 years old fell from 35% in 1976 to 12% in 1979, following legislation making bottles and formula available by prescription only and the education of health personnel concerning the advantages of breast-feeding (Biddulph 1981).

3.6 Strategy 5: Facilities for working women

3.6.1 Description of strategy

Maternal employment is widely cited as a major reason for the decline in breast-feeding throughout the world. Although there is some debate concerning this, it is certainly true that employment constrains the opportunity to breast-feed for many mothers (Esterik and Greiner 1981). There are many ways in which governments can assist women who want to combine breast-feeding with employment. The most important of these include the enactment of legislation requiring:

- the provision of maternity leave;
- the provision of nursing breaks during working hours;
- the establishment of creches at or near a work site.

3.6.2 Cost estimates

To the extent that the strategy designed to increase breast-feeding by working mothers involves the establishment of legislation, the costs presented in Table 3.6 could also be applied here. In addition, governments enacting such legislation may need to give financial assistance for the implementation of steps required under the legislation, either by virtue of being employers themselves or through subsidising private industry costs. The likely magnitude of these costs is discussed below.

The International Labour Office (ILO) advocates the establishment of nurseries either next to or within the work-setting to enable women to breast-feed infants at work. In most cases, the obligation to provide these facilities is with any employer who employs over a minimum number of women, generally from 10 to 100 (Huffman 1984). Assuming labour were the only cost and a full-time child-minder were employed for every 10 children at $1000 per year, the cost per child per year would be $100. This is far more expensive than most of the other breast-feeding promotion strategies reviewed, even without including other costs of facilities or allowing for the fact that not all children would be of breast-feeding age.

The ILO recommends 6-12 weeks' maternity leave for women. We assume 12 weeks paid leave, which would provide four weeks pre-delivery and allow two months of breast-feeding. In addition to the possible costs to industry in the form of the disruption, retraining and reorganisation required to accommodate women temporarily leaving work, there is the basic financial cost (incurred either by government or industry) of the paid leave, equivalent to a quarter of the annual salary of the woman. Assuming salaries lie in the range of $500 to $2000 per year, the cost per woman taking maternity leave is between $125 and $500.

Many developing countries (e.g. China, Haiti, India, Sri Lanka, Tanzania and Tunisia) have specified provisions for nursing breaks for working mothers (Jelliffe 1977). In China, for example, women are allowed 20-30 minutes every three to four hours to nurse their infants. Assuming salaries to lie in the range of $500 to $2000 per year, the salary cost per woman taking nursing breaks is between about $5 and $20 per month of

breast-feeding, $30-120 for a full six months and $60-240 for a year. In most situations, if women are to take advantage of breast-feeding breaks, facilities for caring for babies near the work site are needed and the costs of this service would need to be added to those of the nursing breaks.

3.6.3 Effectiveness estimates

Although many countries have laws providing for maternity leave and child-care facilities, they are seldom rigidly enforced. What impact such laws might potentially have on breast-feeding if they were enforced is not known (Esterik and Greiner 1981). One survey in Malaysia found that 23% of working women who were bottle-feeding would have considered breast-feeding if they had been offered leave without pay, while 39% would have considered it if their working hours could have been rearranged (Consumers Association of Penang 1976). If, say, 90% of women were not at that time breast-feeding and the women who indicated that they would consider the option of breast-feeding actually did so in practice, the reduction in the percentage of non-breast-feeding would be about 30% with the offer of leave without pay, and 50% for rearranged working hours. The usefulness of maternity leave as a mechanism for promoting breast-feeding appears, in some cases, to have been undermined by the health system. For example, in the USA most health workers advise mothers who state that they will return to work, to initiate mixed feeding from birth in order to "accustom" the child to the bottle. This predicts a very short duration of any breast-feeding (Winikoff, personal communication). In order to be effective in promoting breast-feeding, the provision of maternity leave may need to be combined with education of health workers.

3.7 Cost-effectiveness estimates

The effectiveness data for the breast-feeding promotion strategies we have discussed are expressed in terms of changes in breast-feeding behaviour. In order to convert this measure into expected changes in diarrhoea mortality and morbidity, it is important to have the breast-feeding impact data in a suitably disaggregated form by age (since the association between failure to breast-feed and diarrhoea is highly age-

dependent) and by feeding-mode (distinguishing between full, partial and no breast-feeding which have different implications for diarrhoea morbidity and mortality). Unfortunately, many of the effectiveness data are not in this form and the sample of studies with suitable data is small for most of the individual strategies.

In view of the relatively small number of effectiveness results for any particular strategy and the considerable uncertainty that surrounds the significance of differences in impact of breast-feeding between the strategies, we do not attempt to derive separate cost-effectiveness estimates for each strategy. Instead, we assume conservatively that the impact of a package of breast-feeding promotional strategies is no more than the average impact on breast-feeding of the selection of strategies reviewed by Feachem and Koblinsky (1984). This estimate is conservative to the extent that impact is likely to increase as more strategies are added (although if the same group of mothers or the same causes of not breast-feeding are being addressed, this extra impact may not be very great). Based on studies summarised in Winikoff and Baer (1980) and from Hardy et al. (1982), which presented results in a suitably disaggregated form by age, Feachem and Koblinsky (1984) found the median reduction in the proportion of non-breast-fed infants to be 42% (0-2 months), 28% (3-5 months) and 11% (6-11 months). The studies from which these results were derived included a mixture of strategies with an emphasis on hospital-based interventions - both education and changes in hospital routine.

Feachem and Koblinsky consider three different intensities of intervention - high impact (twice the median results quoted above), medium impact (the median) and low impact (half the median). They apply these to three different pre-intervention patterns of breast-feeding, characteristic of "modern", "transitional" and "traditional" communities. Each is associated with different patterns of diarrhoea morbidity and mortality (see Tables 3, 6 and 8 in Feachem and Koblinsky 1984). Estimates of the reduction in the number of diarrhoea episodes and deaths in children due to breast-feeding promotions of different effectiveness are shown in Table 3.7 for the three different pre-intervention patterns of breast-feeding. These estimates are based on relationships at two different stages: firstly, the potential impact of breast-feeding

promotion on breast-feeding rates (which is higher the lower is the existing breast-feeding rate) and, secondly, the potential impact of an increase in breast-feeding rates on diarrhoea morbidity and diarrhoea mortality (which is higher the higher are the existing morbidity and mortality rates). The various determinants do not necessarily change in parallel, and as a result the estimates of the reduction in diarrhoea episodes and deaths do not form a consistent pattern.

Table 3.7. Reduction in the number of diarrhoea episodes and deaths per 1000 children under 5 years by pre-intervention pattern of breast-feeding, due to breast-feeding promotions of different effectiveness

Pre-intervention pattern of breast-feeding[1]	Reduction in the number of diarrhoea episodes and diarrhoea deaths by effectiveness of breast-feeding promotion[2]					
	Morbidity			Mortality		
	High impact	Medium impact	Low impact	High impact	Medium impact	Low impact
A	270	137	70	4.00	1.86	0.93
B	424	205	104	8.42	4.21	2.50
C	379	165	94	11.44	6.24	3.64

1. Breast-feeding pattern A ("modern") is one of high rates of partial and no breast-feeding; pattern C ("traditional") has relatively high rates of exclusive breast-feeding and pattern B ("transitional") is mid-way, with a substantial proportion of children partially breast-fed, (see Feachem and Koblinsky, 1984, Table 3).
2. Derived from Tables 6-9 in Feachem and Koblinsky (1984).

The costs of the five broad strategies designed to increase breast-feeding rates, described in Sections 3.2 to 3.6, reveal considerable variation both between and within strategies. The provision of facilities for working women is by far the most expensive option, with cost per mother exposed possibly over $700 where a woman receives maternity leave, has access to a creche and is given paid time off for breast-feeding. Of the other alternatives, mass media could be one of

the more expensive if sophisticated promotional packages were employed in relatively small populations, but otherwise it would not be difficult to keep costs below $5.00 per mother exposed, and for larger populations below $1.00 (Table 3.5). Hospital-based strategies are relatively inexpensive. For hospitals with over 5000 deliveries per year, a conference plus lobbying designed to change hospital routine together with education of staff, could be done for less than $0.40 per delivery (Tables 3.1 and 3.2). Legislation concerning breast-milk substitutes might be established for under $1.00 per child and in larger populations for less than $0.10 (Table 3.6).

With a judicious selection of strategies it should therefore be possible in many circumstances to implement a package of breast-feeding promotional strategies for between about $1.00 and $10.00 per mother exposed (not including the provision of facilities for working women). These are the figures we will use in deriving the cost-effectiveness results. It may be that a package of strategies will cost less than the sum of the individual costs, although it is not clear how such cost-sharing might be achieved. The size of the population, access to the media and the size of hospitals are important factors which will influence average costs.

Matching cost and effectiveness data is not straightforward. Firstly, costs and effectiveness estimates are clearly not independent: all other things being equal, more expensive promotional exercises may be more effective; and breast-feeding patterns, which determine effectiveness, are also associated with different degrees of affluence and hence likely cost levels. (The "modern" pattern, for example, is typical of more developed countries where programme costs may well be higher.) Secondly, the units in which effectiveness and costs are expressed may not be comparable. In some studies of effectiveness, rates of change of breast-feeding are measured for the population as a whole and not just for the group of mothers-with-infants exposed to the strategies (e.g. Sjolin 1976). In the main, however, effectiveness is measured in terms of changes in breast-feeding rates of mothers exposed to the strategy or, more accurately, for the breast-feeding of those infants born around the time of the mothers' exposure to the strategy. For this reason, we have calculated costs in terms of cost per child whose mother is exposed

to the intervention within a year of its birth, which we have sometimes simplified to "cost per mother exposed".

Putting together the effectiveness results (Table 3.7) with estimates of cost per mother exposed to breast-feeding promotion of $1.00, $5.00 and $10.00 gives the estimated costs per diarrhoea case and diarrhoea death averted shown in Table 3.8. The cost per diarrhoea case averted ranges from between about $2.4 (high impact, low cost programme, "transitional" pre-intervention pattern) and about $143 (low impact, high cost programme, "modern" pre-intervention pattern) For the least expensive package of strategies at $1.00 per mother exposed, the cost per diarrhoea case averted is less than $15 even for lower impact programmes.

Table 3.8. Cost per diarrhoea episode and diarrhoea death averted through breast-feeding promotion in children under 5 years ($US 1982)

Pre-intervention breast feeding[1]	Cost per mother exposed	Cost per diarrhoea episode and diarrhoea death averted by effectiveness of breast-feeding promotion[2]					
		Morbidity			Mortality		
		High impact	Medium impact	Low impact	High impact	Medium impact	Low impact
A	10.00	37.0	73.0	142.9	2 500	5 376	10 753
	5.00	18.5	36.5	71.4	1 250	2 688	5 376
	1.00	3.7	7.3	14.3	250	538	1 075
B	10.00	23.6	48.8	96.2	1 188	2 375	4 000
	5.00	11.8	24.4	48.1	594	1 188	2 000
	1.00	2.4	4.8	9.6	119	237	400
C	10.00	26.4	60.6	106.4	874	1 603	2 747
	5.00	13.2	30.3	53.2	437	801	1 374
	1.00	2.6	6.1	10.6	87	160	275

1. A, B and C as for Table 3.7.
2. Using effectiveness results from Table 3.7.

The cost per diarrhoea death averted ranges from about $87 to $10 750. For the less expensive package of strategies at $1.00 per mother exposed, the cost per diarrhoea death averted is below $550 for all but the low impact programme in a situation with low levels of exclusive breast-feeding and low rates of diarrhoea. For high impact programmes the cost can be under $100 per diarrhoea death averted.

3.8 Comments

In this chapter we have considered some of the main possible options for promoting breast-feeding, derived cost estimates for each and then proposed a range of costs per mother that a package of strategies is likely to involve. These costs were then combined with a range of effectiveness results based on the average of mostly single-strategy programmes. How accurate and relevant are the resulting cost-effectiveness estimates?

On the cost side there is clearly much that could be done to improve the accuracy and reliability of the figures by collecting detailed data on resources used in mounting promotional activities. In the absence of expenditure or detailed input data from actual programmes, rough estimates are all that is possible. It is not unlikely that our figures may underestimate true costs because of a failure to identify all the resources required. Manpower is the major input identified for all the strategies. The salary levels chosen were based on the results of a survey of health personnel from developing countries. This survey indicated that salaries could be as much as double the estimates used here (e.g. in Nigeria and Zimbabwe) while some are as low as one tenth (e.g. Bangladesh and Sudan).

On the effectiveness side there are several potential sources of inaccuracy in individual studies and of bias in the selection of studies. The studies on breast-feeding and diarrhoea reviewed by Feachem and Koblinsky (1984) made use of different methods for collection and analysis of data. Studies judged by them to have serious methodological flaws were rejected but the authors admit that the quality of those that were included varied widely. In particular, they note the failure to define feeding mode adequately or to control for confounding variables.

In addition, there are a number of possible sources of bias. Some of these would lead to overestimates of the achievements of breast-feeding promotion campaigns. For example, unsuccessful projects are perhaps less likely to be reported, and smaller, research-type projects which could stand a better chance of success may be over-represented. On the other hand, there are several reasons for expecting that breast-feeding campaigns could be more effective than the literature suggests. For example, some projects only measure the change in breast-feeding rates for babies born during the period that their mothers were exposed to the strategy. The impact on other children born to the same mother, or born to women not directly exposed to the strategy but who are influenced by changes in other women's behaviour, is sometimes not taken into account. In addition, many of the projects from which effectiveness data have been gathered have involved only one or two component strategies. More comprehensive projects would be expected to achieve even better results. Indeed, it may be that the impact of multiple strategies is more than the sum of their individual effects. "In many cases successful programmes to increase breast-feeding have involved both changes in hospital routine and supply of information and support, which seem to have the potential to interact synergistically" (Winikoff and Baer 1980).

There is also the problem of using data which are largely from the developed world to estimate impact in the developing country setting. It is not immediately clear in which direction the bias might exist, but circumstances differ so greatly that some attempt should be made to gather more data from poorer countries. The effect of bias is to some extent ameliorated here by exploring ranges rather than just medians and taking into account those factors (such as the different pre-intervention patterns of breast-feeding) which are expected to influence the effectiveness results most significantly.

IV IMPROVED WEANING PRACTICES

4.1 Background

Weaning is the transitional stage when a child's diet gradually changes from one of milk alone to a diet based on what the family eats. Weaning begins when the child is introduced to foods other than breast-milk (or a breast-milk substitute) and is completed when the child is fully accustomed to the regular family diet (Gibbons and Griffiths 1984). The weaning period is one of high health risk for the child, attributed principally to two broad causes related to weaning foods - contamination of weaning foods and inadequate nutrition. The link between contamination and diarrhoea is well established (e.g. Black et al. 1982). Malnutrition, while not convincingly associated with increased risk of diarrhoea, does appear to predispose towards increased severity and duration of diarrhoea attacks and towards increased risk of diarrhoea mortality (Ashworth and Feachem 1985c).

Table 4.1 identifies some common examples of faulty weaning practices that place children at risk. The possible explanations for these kinds of inappropriate practices vary considerably from one community to another. In general terms they can be ascribed to three interrelated factors: a lack of knowledge about the consequences of poor weaning practices or how to change them; a higher valuation given to goals that are in conflict with good weaning practices; and inadequate resources for implementing good practices. For each of the faulty weaning practices identified, Table 4.1 also notes plausible explanations in terms of knowledge, priorities and resources. Depending on the nature of the cause of the problem, several alternative solutions are possible. These may be broadly categorised as education, legislation and increased access to resources. Table 4.2 provides examples of these kinds of solutions for each of the main problem areas identified in Table 4.1.

This chapter will focus on the problem of nutrition rather than contamination. This emphasis reflects the state of progress with the WHO series of reviews on the effectiveness of various interventions designed to control diarrhoea: papers dealing with nutritional aspects of weaning have been published (Feachem 1983; Ashworth and Feachem 1985c); the one

Table 4.1 Explanations for poor weaning practices

Weaning practices leading to problems of malnutrition or contamination	Possible reasons for adopting these weaning practices		
	Lack of knowledge	Conflicting goals	Inadequate resources
Nutritional inadequacy			
Using foods of poor nutritional quality (low energy foods, lack of variety)	. unaware of child's needs and the foods or modes of preparation that satisfy them	. food taboos . food believed to cause other problems (e.g. flatulence, diarrhoea, turns teeth black etc.)	. food with good nutrient value is unavailable or expensive or difficult to prepare
Giving insufficient quantity of food (too little, too infrequently, and reducing intake at times of disease)	. unaware of child's needs and consequences of not satisfying them . unaware of how little child gets if shares from family food pot . unaware of child's limited capacity "bulk constraint" and need for frequent small feeds	. child's health valued less than that of other family members . child anorexic . desire for small children who will make fewer demands	. food is scarce or expensive . time is in short supply - mother works . mother debilitated by subsequent pregnancy
Introducing weaning foods too late	. unaware of when child needs to supplement milk	. belief that child cannot digest food at 4-6 months	. food is scarce or expensive
Starting weaning too early	. unaware that child's capacity for digestion develops slowly	. desire to build up child's strength	. mother unable to lactate
Weaning abruptly	. unaware of continuing benefits of breast-milk and how to gradually introduce new foods		. mother has to work - time for breast-feeding unavailable
Contamination			
Using contaminated foods	. unaware of consequences of poor preparation and storage, and how to do it properly		. insufficient time or fuel to cook/ reheat frequently . inadequate storage facilities

Table 4.2. Possible solutions to problems of poor weaning practices

Poor weaning practices	Possible solutions
Using foods of poor nutritional quality	Improving use of currently accessible foods through . education concerning: the child's needs; the consequences of inappropriate feeding; appropriate foods to use; ways to prepare them; methods of identifying inadequate feeding; the relative significance of other effects of foods . legislation against marketing "junk" foods Improving access to appropriate foods through . education concerning ways to cultivate appropriate foods . subsidies on appropriate foods (e.g. fortified cereals, formulated foods or raw materials such as seeds)
Giving insufficient quantity of foods	Increasing use of available foods through . education concerning: methods of identifying malnutrition; the child needs; the consequences of insufficient feeding; ways to improve intrafamilial food distribution; the importance of feeding at times of illness Increasing family access to food through . subsidies on food Reducing potential competitive demands for food and time through . education concerning family planning
Feeding the child infrequently	Increasing the motivation to feed more frequently through . education concerning the child's needs, but limited food capacity and how frequently to feed the child Increasing opportunities to feed more frequently through . legislation providing feeding breaks for working mothers

Table 4.2. continued

Poor weaning practices	Possible solutions
Introducing weaning foods too late	Increasing motivation to feed earlier through . education concerning the need for additional foods at 4-6 months to prevent growth faltering; the ability of children to digest certain foods at 4-6 months; methods of preparing foods for young children Increasing availability of foods though . subsidies
Weaning abruptly	Increasing the motivation to wean less abruptly through . education concerning the continued benefits of breast-milk; the need to introduce new food gradually Increasing the opportunity to do so through . legislation providing longer maternity leave
Using contaminated food or utensils	Increasing the motivation and capacity to reduce contamination through . education concerning the dangers of contaminated foods; ways to prepare and store foods to minimise contamination . subsidising sterile weaning foods
Starting weaning too early	Increasing motivation to avoid early weaning through . education concerning the dangers of early weaning . legislation providing longer maternity leave

on food hygiene is still in preparation. As far as solutions are concerned, some attention is given in this paper to approaches designed to reduce the income constraint and increase access to appropriate

foods. However, the main emphasis will be on education, reflecting the (not undebated) assertion that "a major proportion of malnutrition at weaning age has been shown to be caused by ignorance, incorrect food and health beliefs and resultant poor feeding and health practices, rather than lack of basic food resources" (Zeitlin and Formacion 1981). Educational strategies appear to have considerable potential in reducing malnutrition during the weaning period, potential which a recent review suggests can be effectively tapped (Ashworth and Feachem 1985c).

4.2 Description of the intervention

Weaning education programmes can be broadly defined in terms of who the message is aimed at (the educational target) and the channels through which the message is conveyed (the education delivery system). These two dimensions provide a useful framework in which to situate alternative weaning education approaches. The primary educational targets should probably be those responsible for preparing weaning foods for young children. Usually this will be the mother, but sometimes also siblings, grandmothers or other relatives, particularly if the mother is working and separated from the child (e.g. Brown and Brown 1979). In communities in many parts of the world much of the care of young children is provided by older siblings. "These young 'child-minders' not only play with their smaller brothers and sisters but carry them about and even bathe, change and feed them" (Anonymous 1984). Occasionally, child-minders outside the family who care for many children may be responsible for feeding the child. Weaning education might also be directed to others who are effective indirect channels for conveying new information, such as school children, or who may be reinforcing inappropriate feeding practices, such as grandmothers or husbands, who in some areas are responsible for determining what the family eats (CARE/India 1973; Balcomb 1977).

There are two main channels through which messages to these educational targets might be conveyed - mass media and face-to-face. Both of these have been used successfully to provide weaning education in various settings (Gibbons and Griffiths 1984). Not infrequently, the two are used together (e.g. Zeitlin et al. 1984). The main delivery systems for mass media in the developing world are usually radio and posters, and

occasionally television and newspapers. Face-to-face education can take place on an individual basis or in groups which may be either pre-existing or specially formed for weaning education; it can be carried out by volunteers or workers specialised in this area or by individuals with other responsibilities; it can take place in homes, health centres, schools or other community institutions. There are clear potential gains in cost-effectiveness terms in taking advantage of existing infrastructures (such as schools and health centres), well-trained personnel already in contact with the target group (for example teachers and health staff) and natural groupings of the target population (including mothers' clubs and immunisation sessions). Situations in which the educational target is particularly likely to be responsive or children are likely to gain more from improved weaning practices (for example supplementary food schemes or rehabilitation centres), offer special potential. Table 4.3 identifies some approaches which appear to be particularly promising.

A variety of strategies other than education is identified in Table 4.2. Legislation is one of these. For instance, feeding breaks can be established for working mothers to increase the availability of that potentially important resource for good weaning - mothers' time; the quality of commercial weaning products and the advertising or marketing of foods can be regulated to discourage the inappropriate feeding of children being weaned. Legislation, however, has limited scope in combating weaning malnutrition, is difficult to target appropriately and is rarely used specifically for that purpose.

Lack of resources is commonly cited as an important cause of malnutrition. "Malnutrition is largely a reflection of poverty: people do not have enough income for food" (World Bank 1980). Several approaches to ameliorating the constraint of limited purchasing power have been advocated and implemented. These range from general strategies of income transfer by land reform, through increasing agricultural productivity, to food hand-outs. In Section 4.3.3 we explore the likely efficiency of food subsidies as a strategy for reducing weaning malnutrition and death from diarrhoea.

Table 4.3 Weaning education delivery system and targets

Delivery strategy		Primary educational target	Primary health target
Venue/Media	Educators		
Face-to-face			
Schools	Teachers	School children	Siblings 6 months - 2 years
Health centres . infant welfare . growth monitoring	Health workers	Mothers attending infant welfare clinics	Children 6 months - 2 years
Rehabilitation centres	Health workers	Mothers bringing malnourished children	Malnourished child and siblings
Food distribution/ supplementation centres	Centre staff	Mothers receiving food supplements	Children 6 months - 2 years
Existing community groups, e.g. . literacy classes . agricultural groups . religious groups . women's clubs	Adult educators Extension workers Religious leaders	Mothers	Children 6 months - 2 years
New community groups	Special cadres or existing ones (eg TBAs, health workers)	Mothers	Children 6 months - 2 years
Individual visits	Special cadres or existing ones (e.g. TBAs, health workers)	Mothers	Children 6 months - 2 years
Mass media . radio . television . posters . drama . cinema . newspapers		Mothers fathers & others in community	Children 6 months - 2 years

4.3 Cost-effectiveness

Nutrition education programmes are common throughout the developing world: 91% of the 201 nutrition projects in 66 countries surveyed by the Harvard Institute for International Development (Austin et al. 1978) reported undertaking some kind of nutrition education. Much of this education is directed at improving childhood nutrition and many of the delivery strategies outlined in Table 4.3 have been employed. Unfortunately, evaluation is less common than implementation, and evaluations which measure nutritional status as well as knowledge or behaviour changes are rarer still. To estimate the impact on diarrhoea mortality, nutritional data of a specific kind are necessary. The association of poor nutritional status with diarrhoea mortality (Black et al. 1984; Chen et al. 1980) has been demonstrated for moderately and severely malnourished children (i.e. 60-74% weight-for-age and less than 60% weight-for-age respectively). The changing proportion of children in these categories therefore needs to be known.

Ashworth and Feachem (1985c) identify 17 projects which measured the effect of weaning education on nutritional status; nine of these provided data adequate for estimating the impact on diarrhoea mortality. Cost data are in even shorter supply; only seven weaning education projects with cost estimates were located. Four of these provided data on both costs and nutritional impact. One, in Morocco, was attached to a supplementary feeding programme (Gilmore et al. 1980). The other three were community-based: one in Burkina Faso (Zeitlin 1981), one in the Philippines (Jones and Munger 1978), and one in Indonesia (Zeitlin et al. 1984). All four involved face-to-face education of mothers.

We examine these four projects in some detail, paying particular attention to the nature and limitations of the cost and effectiveness data, exploring the consequences for cost-effectiveness results of altering certain assumptions and identifying some issues of interest in relation to face-to-face education. The potential of mass media and factors likely to influence their cost-effectiveness for weaning education are explored in Section 4.3.2. Section 4.3.3 discusses food subsidies as an approach to reducing weaning malnutrition.

Table 4.4 Summary of cost-effectiveness calculations for four weaning education case studies

Country	Proportion of children Malnourished[1]		Reduction in diarrhoea mortality rate in benefiting under-5s[2] (R)	No. of diarrhoea deaths averted in under-5s per 1000 benefiting children per 5 years[3] (D)	Total annual cost for nutritional education ($US 1982)	No. of benefiting children per year	No. of years each benefiting child participates	Total cost per benefiting under-5 ($US 1982)	Cost per diarrhoea death averted in children
	Participants (P)	Controls (C)							
Morocco	16%	34%	8.1%	5.64	300 000	150 000 x 2	2.5	2.50	440
Burkina Faso	12%	35%	10.2%	7.16	1 880	18 000 x 1.5/5	1.5	0.52	73
Philippines	42%	64%	8.0%	5.63	7 890	836	1.0	9.44	1670
Indonesia	15%	32%	7.7%	5.40	63 000	50 000 x 14/60	1.2	6.30	1160

1. Less than 75% weight-for-age (Indonesia, Burkina Faso); less than 80% weight-for-age (Morocco, Philippines).

2. $R = \frac{C-P}{C+100} \times 0.6 \times 100$ assuming that:

   (a) differences between controls and participants represent the impact of the weaning programme.
   (b) children less than 75% (or 80%) weight-for-age have a two times higher diarrhoea mortality rate than other children (see Ashworth and Feachem 1985c).
   (c) the impact of the weaning education programme is on 60% of diarrhoea deaths in the first five years of life (the average of the conservative (47%) and optimistic (74%) assumptions in Ashworth and Feachem (1985c).

3. $D = \frac{R}{100} \times 14 \times 5$ assuming that average annual diarrhoea mortality is 14 per 1000.

4.3.1 Face-to-face education of mothers

Case study 1: Morocco

In 1975 an educational component was added to a supplementary feeding programme in Morocco which had been operating since 1972. Each month when mothers from families certified to be below the poverty line came to collect their substantial food rations they received 20-50 minutes of instruction covering nutrition, health, sanitation and food preparation topics.

An evaluation carried out in 1978 found that the nutritional impact of this education was substantial (reported in Gilmore et al. 1980). Comparisons were made between children receiving both supplements and education in 1978 and their older siblings when they had been enrolled in the supplement-only programme three years before. It was found that 16% of the former group of children (2.5 to 5 years of age) were less than 80% weight-for-age compared to 34% of their older siblings at a comparable age. The evaluators thought this difference unlikely to be due to differences in the supplement component or long-term secular trends in Morocco. The documented substantial changes in weaning practices (for example, abrupt weaning fell from 91% in 1975 to 15% in 1978) lend support to the claim that education was responsible for the nutritional differences. Employing assumptions detailed in footnotes to Table 4.4, the presumed reduction in malnutrition is translated into the total number of diarrhoea deaths in children under 5 years old averted per 1000 children benefiting from the nutrition education (i.e. 5.64 deaths averted).

The highly aggregated cost data presented by Gilmore et al. (1980) show that annual costs per family benefiting were $103, with the mother and two children in each family receiving supplementary food. Approximately 1% of these costs (i.e. $1) reflects the direct additional costs of operating the educational programme. Hornik (1985) suggests that, if administration and other costs are shared between components, the costs for education may be as much as 3% of the total (i.e. $3 per family). Adopting the average of the two cost estimates gives a cost per family per year of $2.

If each family participates in the programme for two and a half years (Gilmore et al. found that this was the average) and two children benefit from this, then the total cost per benefiting child is $2.5. Putting this together with the effectiveness data gives an estimate of $440 per diarrhoea death averted. Table 4.5 explores the consequences of varying some of the assumptions adopted in deriving this estimate. It shows at one extreme an estimate of nearly $5000 per death averted and, at the other, only $100. $500 to $1000 per death averted would appear to be a plausible range.

Table 4.5 Cost-effectiveness sensitivity analysis: Morocco Project

Proportion of diarrhoea deaths in under-5s benefiting from the inter-vention	Annual diarrhoea mortality rate per 1000 under-5s	Cost per diarrhoea death averted in under-5s ($US 1982) by costs of education and number of children benefiting					
		Costs of education as % of total costs					
		1%		2%		3%	
		No. of children benefiting per mother educated					
		1	2	1	2	1	2
47%	25	320	160	640	320	960	480
	14	570	280	1140	570	1710	840
	5	1590	800	3180	1590	4770	2400
60%	25	250	120	500	250	750	360
	14	440	220	880	440	1320	660
	5	1240	620	2480	1240	3720	1860
74%	25	200	100	400	200	600	300
	14	360	180	720	360	1080	540
	5	1010	500	2020	1010	3030	1500

Case-study 2: Burkina Faso

Weaning education has been an important component of a village-based health/nutrition programme operating in Yako in Burkina Faso (Zeitlin 1981). In addition to village primary health care workers and midwives, 300 village weaning monitors operate in the area which has a population

of some 100 000 including 18 000 preschool children. Weaning monitors, who are illiterate volunteer mothers, attend monthly meetings with their public health nurse supervisor, learn the lesson for that month and return to their village to repeat the lesson and give cooking demonstrations to neighbouring mothers.

An evaluation of this programme was carried out in 1978 after seven years of implementation. The nutritional status of children aged 6-24 months in Yako was compared with that of young children in Koupele, an area roughly comparable in terms of key socio-economic characteristics, but where nutrition education was provided by home economists without the village-level extension system employed in Yako. The survey found that only 12% of surveyed children in Yako were below 75% weight-for-age, compared to 35% of those in Koupele. The difference was statistically significant. While not ruling out the possibility that other elements of the village extension programme contributed to these results, the finding that Yako's infants started supplementary foods earlier, ate larger quantities of better quality food and that these factors were correlated with higher nutritional status supports the suggestion that weaning education played a major role in reducing malnutrition. Converting the difference in malnutrition rates to an estimate of the number of diarrhoea deaths averted in children under 5 years (using assumptions described in the footnotes to Table 4.4) suggests that 7.16 diarrhoea deaths per 1000 benefiting children will be averted.

Zeitlin (1981) reports the costs for the programme in some detail. Table 4.6, adapted from that source, shows the annual costs of the Yako village-level health and nutrition campaign which are additional to those of the typical district health programme onto which the village programme is grafted. There are several ways of utilising these costs in deriving cost-effectiveness estimates. One is to look solely at additional fiscal costs incurred in implementing the weaning education component (i.e. $440 per year for training of weaning food monitors - see A, Table 4.6). This approach, however, takes no account of the value of the time that volunteer monitors devote to weaning education and gives a misleading impression of the effort involved in mounting the weaning education component. Zeitlin (1981) develops estimates of the

Table 4.6 Total annual costs: Burkina Faso nutrition and health project

Programme		Nature of costs	Aspect of service	Total annual costs ($US 1982)
A	Weaning education	Fiscal	Provision	440
B	Weaning education	Fiscal + opportunity costs	Provision	1 880
C	Health + weaning education	Fiscal	Provision	29 260
D	Health + weaning education	Fiscal + opportunity costs	Provision	30 700
E	Weaning education	Fiscal + opportunity costs	Provision + consumption[1]	182 813

1. Includes costs to families of attending education sessions and using additional foods.

value of rural women's time based on potential earnings from trading, market gardening or crafts, and calculates that the total value of the weaning monitors' time devoted to weaning education is $1440 per year. Adding this to fiscal payments for monitor training gives a total cost estimate of $1880 per year (B, Table 4.6).

There is also an argument for including the costs of the whole health/ nutrition project in cost-effectiveness estimates. It seems highly likely that other components in the broader health programme at village level have also influenced the nutrition outcome either directly (e.g. market gardening) or indirectly via reduction in disease (e.g. through the PHC and water supply interventions). There was also some doubt as to whether the weaning nutrition component could operate effectively without the other health elements. Lines C and D in Table 4.6 show total costs (using respectively fiscal costs only and fiscal plus opportunity costs of volunteer labour) for the combined health and nutrition programme.

This study is one of the few which considers the cost to mothers of attending educational sessions and adopting the weaning practices recommended. Zeitlin (1981) estimates that the additional annual costs (termed "consumption costs") borne by Yako families were $10 460 for mothers' time in attending nutrition education sessions and preparing the weaning foods, and $196 070 for the weaning food itself. These figures highlight the significance of the families' contribution to improving weaning practices. Consumption costs are estimated to be five times provider costs even when volunteer contributions and other health components are included in the latter. Line E shows the total annual cost of the programme if both the "provision" and "consumption" aspects are included.

Table 4.7 illustrates how cost-effectiveness estimates vary depending on which costs are included and how diarrhoea mortality impact is derived. Estimates range from as low as under $10 per death averted to over $4000. Focusing just on weaning education and including both fiscal and opportunity costs, suggests a range of costs per death averted of about $50 to $200.

Table 4.7 Cost-effectiveness: Burkina Faso project

Proportion of diarrhoea deaths in under-5s benefiting from the intervention	Annual diarrhoea mortality rate per 1000 under-5s	Cost per diarrhoea death averted in under-5s ($US 1982) for different total costs		
		Total annual costs ($US 1982)		
		A ($440)	B ($1880)	D ($30 700)
47%	25	12	52	852
	14	22	93	1521
	5	61	261	4260
60%	25	10	41	667
	14	17	73	1192
	5	48	204	3337
75%	25	8	33	541
	14	14	59	966
	5	39	166	2706

Case study 3: The Philippines

In 1975 a programme to combat malnutrition in young children was initiated by the Bureau of Agricultural Extension in the Philippines. The programme involved education of mothers in groups for 3-4 hours once a week for a period of one year. These "homemaker" classes covered five broad areas, one of which was nutrition. Nutritional sessions focused on encouraging mothers to provide supplementary foods to infants by their fifth month using locally grown foods, and to establish gardens. Women were taught how to prepare a variety of weaning foods and infants were weighed monthly.

An evaluation was carried out one year after the initiation of the programme. The nutritional status of children aged 0-18 months whose mothers were attending homemaker classes was compared with that of children in areas not covered by the programme. Sixty-four per cent of the children in the control group were found to be malnourished (less than 80% weight-for-age) while only 42% in the study group fell into this category. Nutritional status in the control and study groups had been similar in a pre-programme baseline study. Using the assumptions from Table 4.4, the presumed change in nutritional status translates into an estimate of 5.63 diarrhoea deaths averted per 1000 beneficiaries, or 4.71 averted deaths for the 836 children benefiting in this programme.

A breakdown of the total annual costs (amounting to $7890) is provided by Jones and Munger (1978). The full salary costs of the staff field workers appear to have been included in these estimates, although nutrition was only one of five major topics covered in the classes. Salaries account for 95% of total costs. Allocation of staff costs according to the proportion of time spent on nutrition, therefore, would reduce costs considerably. On the other hand, none of the higher level administrative expenses, except for the immediate supervisors' time, or the costs of curriculum preparation or staff training are included in the estimate.

The cost estimate of $7890 and the estimate of 4.71 diarrhoea deaths averted for one year of the programme suggest that this nutrition

education programme costs $1670 per diarrhoea death averted. In Table 4.8 we explore the consequences of altering some of the assumptions used in deriving costs and benefits. The results range from under $400 to nearly $6000 per death averted, $500 to $2000 being a plausible range.

Table 4.8 Cost effectiveness: Philippines nutrition education project

Proportion of diarrhoea deaths in under-5s benefiting from the intervention	Annual diarrhoea mortality rate per 1000 under-5s	Cost per diarrhoea death averted in under-5s ($US 1982) for two values of cost per child benefiting	
		$9.4 (1 child benefiting per mother educated)	$4.7 (2 children benefiting per mother educated)
47%	25	1190	590
	14	2130	1060
	5	5960	2980
60%	25	930	460
	14	1670	830
	5	4670	2330
74%	25	760	380
	14	1350	670
	5	3790	1890

Case study 4: Indonesia

In 1977 a nutrition education programme, building on an existing base of nutrition volunteers (Kaders), was initiated in five subdistricts of Indonesia with a total population of about 225 000. The programme began with nine months of intensive developmental research. This involved working closely with village communities and mothers to ascertain current practices, attitudes and problem areas, and to design effective and appropriate weaning foods. Two thousand Kaders were retrained, weighing programmes were initiated in every village, radio messages designed and broadcast and "action posters" distributed to mothers to remind them of essential messages being conveyed by Kaders and radio.

The project was evaluated in late 1981, 15 months after commencement of the implementation phase, through a survey of 600 households in the project area and 400 comparison households which were served by Kaders but did not have the additional nutritional education component (Zeitlin et al. 1984). The areas were roughly comparable in socio-economic terms. A significant difference in nutritional status was found. Fifteen per cent of children aged 9-23 months in the project area were malnourished (under 75% weight-for-age) compared with 32% in the control area. In addition there was a documented decline in malnutrition in the study over the life of the project and significant differences were found in weaning knowledge, attitudes and practices between the two areas. These findings support the conclusion that nutritional improvements had occurred as a result of the nutrition education programme. The use of radio was not thought to contribute significantly in this case, principally because messages were given very little air-time. Using the fall in percentage of malnourished children and the assumptions listed in Table 4.4, it is estimated that 5.4 diarrhoea deaths in children under 5 years were averted per 1000 benefiting children

Ho (1985) presents the costs of this project in some detail, dividing them into two major parts: non-recurrent costs (those "up-front" costs incurred for the initial developmental research, message and material design) and recurrent costs, which relate to on-going implementation of the programme. In each category there are some costs which do not change with scale (fixed) and others which increase with the size of the activity (variable). There are several ways in which one could estimate annual costs of this programme for the purpose of deriving cost-effectiveness estimates: $146 000 per annum if all costs are shared out, $63 000 per annum using just recurrent costs and as little as $40 304 per annum if only variable recurrent costs are included. The last estimate, while appropriate for costing the expansion of an existing programme, is misleadingly low as an estimate of the cost of implementing the project from scratch. The potential significance of the preliminary research preparation and design, which are frequently neglected in cost estimates, is well illustrated in this example where they consume more than 50% of total project costs over the first four years.

One major limitation of the costing data is the failure to provide any estimate of the value of the considerable voluntary contributions to the project. Only actual financial costs are included and no value is placed, for example, on the free time provided for radio broadcasts. More importantly, unpaid Kaders retrained by the project were spending, on average, approximately double the time of other Kaders on nutrition education activities (13 hours per month compared with seven hours, the equivalent of about an extra day a month). For the area as a whole this translates into an extra 100 women working years per year (2000 Kaders each spending 1/20 of a working year), a not insignificant contribution, and one which could not be counted on in many other countries.

Table 4.9 illustrates how cost-effectiveness estimates change depending on the assumptions adopted concerning costs and outcomes. The analysis suggests that cost-effectiveness could be as unfavourable as nearly $10 000 per diarrhoea death averted to as low as $500. Using the total recurrent cost estimates (which exclude the initial start-up costs) and the assumptions listed in Table 4.4, the cost per diarrhoea death averted in children under 5 years is estimated to be about $1200.

Table 4.9 Cost-effectiveness: Indonesia nutrition education project

Proportion of diarrhoea deaths in under-5s benefiting from the intervention	Annual diarrhoea mortality rate per 1000 under-5s 5 years	Cost per diarrhoea death averted in under-5s ($US 1982) for different estimates of annual cost		
		$40 000 (variable recurrent)	$63 000 (total recurrent)	$147 000 (total recurrent + annualised non-recurrent)
47%	25	530	830	1940
	14	940	1490	3470
	5	2640	4160	9700
60%	25	410	650	1520
	14	740	1160	2720
	5	2070	3260	7620
75%	25	340	530	1230
	14	600	940	2200
	5	1680	2640	6160

Issues in face-to-face education of mothers

Two of the four case studies analysed above (those in Indonesia and Burkina Faso) give considerable emphasis to individual education of mothers. In these projects it was possible to achieve a 53% and 66% fall respectively in the prevalence of malnutrition. Similar substantial changes have been recorded in other studies involving house-to-house education. Most effective house-to-house programmes involve quite regular contacts; (for example, in a project in the Punjab, reported by Cowan and Dhanoa (1983), visits were made at least every second day.) Clearly this is potentially an expensive exercise and may not be cost-effective unless some of the following pertain:

- it is possible to build on other extension activities such as primary health care or agricultural extension programmes which already reach individual homes, taking care not to overload home visitors with too many messages;
- the target group is highly selected and only the mothers of children most at risk are contacted;
- cheap labour can be employed effectively. In many projects where house-to- house visiting is important, volunteers are used. This considerably reduces the costs borne by government but there may be limits to its effectiveness in the long term, particularly as drop-out rates tend to be high. Wages are a good incentive, particularly if they can be related closely to work performance. The BRAC project in Bangladesh, which pays workers on a scale according to how well they taught mothers how to mix oral rehydration solution (Carriere 1983), offers an interesting example of a method which may have some potential in the weaning field.

Where house-to-house visits are not feasible, group education of mothers may be a viable option. Costs per mother for any given length of exposure to the weaning messages will fall roughly in proportion to the size of the group. How effectiveness responds to changes in group size is not well studied. There is some evidence to suggest that one-to-one education in the home may be more effective. A project in Thailand found that the impact of education was substantially greater with home-

visiting than where mothers came to a central location: the former achieved a 75% reduction in malnourished children (less than 75% weight-for-age), the latter 41% (Vijayaraghavan et al. 1983). On the other hand, evidence from some other health education efforts suggests that while individual tuition offers advantages in the form of potential for adaptation of style and content to individual circumstances, group discussions can actually achieve better results as a consequence of community interaction and reinforcement. Furthermore, the data from the Philippines and Thailand show that it is possible to achieve good results in groups - any loss in potential effectiveness may be outweighed by cost savings.

Group education may take several forms. One approach is to gather women together specifically for the purpose of providing health and nutrition education. However, while this can work (as the results from the Philippines demonstrate), motivation to attend regularly cannot always be guaranteed. Mothers may not see the opportunity to learn about improving childhood nutrition as an adequate incentive to attend educational sessions. This is not an uncommon phenomenon and a variety of strategies have been explored in efforts to overcome it. One tactic is to identify locations and times, such as markets and festive occasions, where women gather for other purposes and to take advantage of these - employing traditional entertainers, medicine showmen (Simoni et al. 1982) and even magic (Dokkum 1978) to attract attention. Occasions on which women gather to learn or to discuss issues of interest (e.g. women's clubs) may be particularly suitable for conveying information on weaning (Chandrasekar et al. 1980). Health centres, though common venues for nutritional education which apparently offer considerable cost advantages, do not appear to have been generally very successful, with nurses inadequately trained as educators and sessions often noisy and chaotic. Careful planning and execution could make education based in health centres cost-effective, but experience to date suggests that this potential has not often been tapped. Rehabilitation centres have been used as sites for nutritional education with some success (Webb et al. 1975).

Another approach is to provide incentives for women to attend health education sessions by, for example, making the receipt of a service or

reward conditional on attendance. The substantial food rations provided by the Moroccan supplementary feeding programme could only be obtained if mothers also attended nutrition education classes: "it is generally believed that without food the women would not attend the nutrition courses" (Gilmore et al. 1980). In Kerala, India, the Kottar social service society has made the right to participate in decision-making about expenditures from a primary health care fund contingent on the mothers regularly attending health education classes (Favin 1986). The process can work the other way as well: involvement in problem identification, financing or decision-making can stimulate more active participation. Mothers, no matter how poor, all pay towards the food and nutrition programme in Morocco and this, claims the evaluation, develops in mothers a sense of responsibility for the food donations and education and may have contributed to the success of the programme (Gilmore et al. 1980). Direct rewards for good results is also a technique which has been successfully employed. Guthrie (1981) describes how "prizes for prudent mothers", in the form of redeemable health coupons or colour photographs of their babies for those who followed good weaning practices, resulted in better growth of young children in an area of the Philippines.

One approach which can significantly reduce the effort some women have to make in order to receive weaning advice is the use of the mass media. In the following section we consider the potential of mass media as a channel for promoting improved weaning practices.

4.3.2. Mass media

A variety of forms of mass media have been employed in nutrition education exercises. While there are some success stories using non-broadcast media (for example, tapes played at communal wash houses in Guatemala were effective in promoting the use of a formulated weaning food (Colle 1977)), most attention has focused on radio. Nineteen per cent of nutrition education programmes surveyed by Austin et al. (1978) reported using radio, though evaluations of the impact are scarce. Radio clearly has considerable potential for reaching large numbers - with an average of 1 in 10 persons in developing countries owning a radio (UNESCO 1984) - and even the poorer communities frequently have

good access. A year-long weaning campaign in Korea - with twice daily radio broadcasts, calendars and comic books - reached 90% of the urban and rural population (Higgins and Montague 1972). Because the message is delivered in the home, radio does not require that the target be strongly motivated to receive the message, particularly if the broadcasts are made during peak listening time and "spots" of short duration are used.

Radio is capable of creating awareness of nutrition messages in a very high percentage of listeners within a time span of a few weeks or months. Campaigns in India showed an increase in the proportion of women knowledgable about weaning foods from 59% to 93% (Rasmuson 1977). In a weaning education programme in the Philippines, which relied solely on radio, 75% of houses randomly sampled after one year were able to identify the nutrition message despite the fact that only 48% of families owned radios (Cooke and Romweber 1977). There is less evidence concerning changes in behaviour. In the Philippines project, self-reported behaviour changes were very small even among those who were classified as adopters. No mass media weaning projects have been located which document nutritional improvements. Some health promotion activities involving principally mass media have been successful in increasing awareness and skills (for instance the ORT promotion programme in Egypt); in Mexico, Cerqueira et al. (1979) found that changes in nutrition could be induced equally well by face-to-face contact or by radio, posters and pamphlets alone. However, it is generally agreed that in order to change habits or teach skills, mass media usually need to be complemented by home visits or some other form of personal contact (Favin 1986). Whether on its own or to reinforce messages provided through other channels, it is likely that the use of mass media is an appropriate strategy for promoting good weaning practices.

One of the major potential difficulties in using the mass media to promote improved weaning practices lies in determining the appropriate message(s) to convey. Message design is important with all educational approaches, but this is particularly so with mass media which do not readily afford the opportunity of modifying or clarifying messages once the programme has been initiated. Furthermore, any health promotion

campaign confronts the problem of message design, but weaning programmes perhaps more than most. Unlike handwashing promotion, for example, where a single behavioural change is desired and can be universally promoted, advice concerning weaning tends to be multifaceted and conditional. While some general guidelines can be proposed (for instance to start weaning at 4-6 months; to use concentrated high-energy foods; to feed regularly using cup and spoon; and to increase quantity and variety over time), specific recommendations must take into account such factors as the age of the child, the kinds of foods and amount of time and money available and the nature of relevant beliefs.

A message which fails to take into account the constraints facing families is unlikely to be acted on, even if it is received and understood. This may sometimes mean promoting a less than ideal behaviour; poorer mothers in the Punjab did not comply with weaning messages until these were altered to minimise money demands (Cowan and Dhanoa 1983). Where time rather than money is the major constraint, women might be encouraged to purchase appropriate processed foods. When the opposite is the case, techniques such as malting which are time-consuming but improve food quality could be recommended.

Some forms of behaviour appear to be particularly difficult to change. The timing of the initiation of weaning is one of these (Zeitlin et al. 1984). It may be more cost-effective to concentrate on promoting other aspects, such as the use of good quality weaning foods once weaning is initiated, particularly as there is some evidence that differences in the timing of weaning may reflect the mother's appreciation of when the child requires additional foods (Sathian et al. 1983). Success in counteracting one malpractice may obviate the need to address others. For example, if the use of more nutrient-dense feeds can be encouraged, it may not be necessary to promote more frequent feeding. Only important problems (importance being a function both of how common the malpractice is and the degree to which nutritional status is affected by changing it) should be addressed and minimal messages conveyed.

Since the ideal weaning message is so circumstance-specific, preliminary research is needed to formulate it. Research requires resources. How much research is cost-effective will depend on how easily the

information can be collected and how much difference the data make to the success of the message. For a large project where inappropriate message design would be expensive and difficult to modify subsequently (as with mass media), more initial research is justified. Data on the relative cost-effectiveness of different levels of preliminary research have not been located, but Hornik (1985) argues that "the results [of the research in finding out more about the audience], at least as reflected in the Indonesian nutritional educational project and the Honduran and the Gambian Mass Media Health Projects, suggest such investment is worthwhile". Inadequate research of this kind might go some way towards explaining the poor record of nutrition education in general. "Funds spent on prior investigation of the issue being addressed, on the shaping and pretesting of the messages to be offered, on audience response are minimal in most projects" (Hornik 1985).

In the previous chapter on breast-feeding promotion we explored the cost implications of mass media in some detail. That analysis suggests that where populations are relatively large and access to radio is good, costs per mother for even quite sophisticated campaigns could be kept below $0.50 per year.

4.3.3 Increasing access to food

Food price subsidy schemes are widespread in the developing world (Rogers et al. 1981). They exhibit a number of variations: the level of subsidy, whether the subsidy is explicit or implicit, the degree of targeting to specific consumers, what food is subsidised and how the subsidised food is distributed. As far as weaning malnutrition is concerned, one of the key factors determining cost-effectiveness is the nature of the food subsidised.

Basic food staples are commonly subsidised foods, but this is unlikely to be a cost-effective approach to reducing malnutrition in young children. Even if price changes encourage families to purchase more of the staple (the relatively few attempts to quantify impact suggest that they may do so (Rogers and Levinson 1976)), there is no guarantee that the weaning child will benefit. Established patterns of food allocation within families may work against this. Furthermore, in order to

increase consumption of the staple by young children by this method, the consumption of the staple by others in society will also have to be subsidised. Finally, given that food quality as well as quantity is generally a problem, offering the young child increased amounts of a staple may have relatively little impact on nutrition.

One approach which goes part of the way towards solving the quality problem is to subsidise cereals fortified with proteins. However, none of the protein fortification programmes which have been evaluated for their impact on nutritional or health status of children were able to demonstrate significant anthropometric or biochemical effects (Austin et al. 1981). Nutrient intake was apparently inadequate. Furthermore, the costs of fortification can be as much as 25% of the cost of the grain (Austin et al. 1981) and targeting is difficult.

It is easier to focus on the weaning child by subsidising nutrient-dense formulated foods; by their nature they generally appeal less to other age groups and this can be reinforced through marketing strategies. They can also be designed specifically to suit the young child's needs in terms of nutrients and food consistency. In addition, they can provide a vehicle for instructing women on appropriate quantities, frequency of feeding and timing of introduction of weaning foods.

The major options for processing formulated foods are home mixing, village-level production or industrial processing. Many countries have experience with industrially produced weaning foods: Heimendinger et al. (1981) cite over 70 formulated weaning foods used in over 30 countries. Suitable weaning foods can be produced using a variety of different raw materials, processing techniques and final product forms and have been shown to have the potential to alleviate malnutrition if consumed by the needy child. Unfortunately, experience with these foods suggests that the target group is frequently not being effectively reached (WFP 1976), and that one of the major reasons for this is that prices are too high for low income groups. "Incaparina", for example, is a weaning food developed in Central America and successfully marketed throughout the region. Its cost, however, places it beyond the purchasing power of the needy and this has emerged as its most significant failing (Gibbons and Griffiths 1984).

It may be necessary to subsidise these foods quite substantially if they are to reach the poorer groups where potential impact is greatest. "In the past, attempts to make products commercially viable yet affordable to target groups have been unsuccessful" (Heimendinger et al. 1981). Targeting subsidised foods to identified sectors of the population (for instance through food coupons issued on the basis of income and/or family size) is one way of making foods accessible to needy groups while moderating costs to government. The costs of establishing and administering eligibility restrictions, however, need to be considered in determining the relative efficiency of these approaches. In Sri Lanka, the cereal-base weaning food "Thriposha" is targeted by requiring that families be referred by health personnel if they are to receive it via health, state and municipal clinics (Gibbons and Griffiths 1984).

Subsidies do not automatically make formulated foods more accessible to everyone. For those outside the cash economy any marketed food, whatever the price, will be inaccessible. If outlets are difficult to get to and not frequented, then even a free product may not be widely used. In some cases, rather than stimulating demand, low prices can actually discourage it. A recent attempt to market a new weaning food in Morocco failed despite the fact that the product was priced below competing brand names and was even available free in health centres. Apparently, the low price and low grade packaging led to a popular perception of it as a low status food. Even if subsidies increase demand for the weaning food, failure to prepare or use the food properly can create problems. Foods intended as supplements have in some areas been widely used as complete baby-foods and have created serious problems of malnutrition (Wickstrom 1972).

There have been some individual good achievements with supplementary feeding schemes, but on the whole results have been disappointing (Beaton and Ghassemi 1982). It appears that many schemes fail to determine accurately the nutritional requirements of the children they are feeding. They do not take into account that much of the food in take-home programmes may be shared with other family members, and that even when food is consumed on-site much of it is replacing rather than supplementing the normal diet. Programmes have been particularly

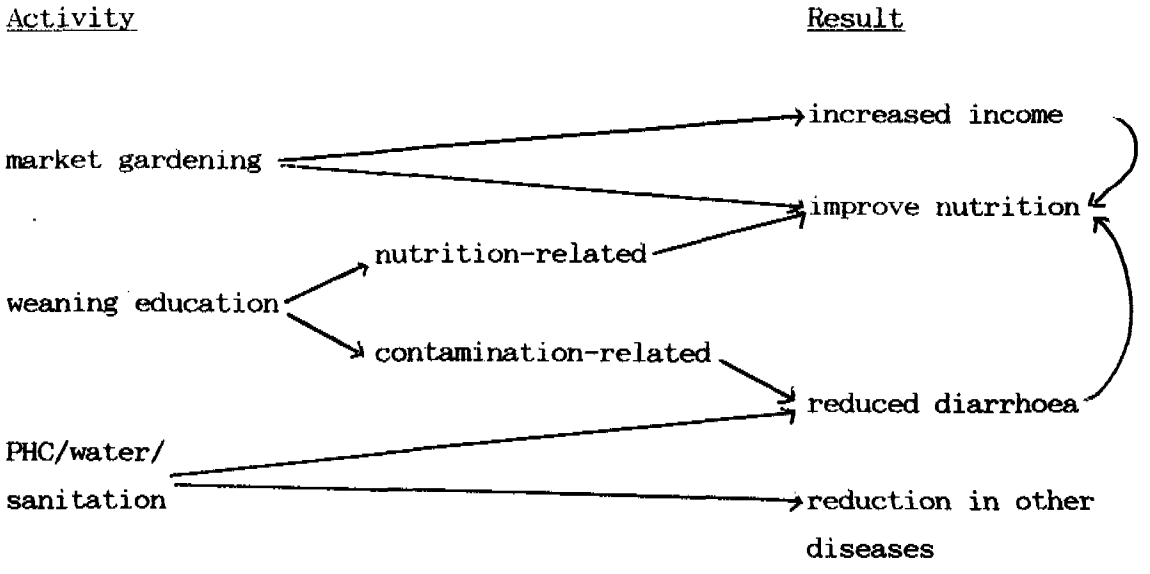
ineffective in the 6-23 month age group in which diarrhoea morbidity and mortality rates are highest. Furthermore, supplementary feeding programmes are not cheap, with costs per participating child of the order of $50-$150. Feachem (1983) in his review concludes that "it is unlikely that supplementary feeding programmes are a cost-effective intervention for national diarrhoeal diseases control programmes".

Village-based activities which combine weaning education with support for food production may be a more economically viable approach. In Thailand, a nutrition fund has been established to develop weaning food recipes for production at village level, to create demand for weaning foods and to strengthen the cooperative efforts of the villages. Food processing centres have been set up in some villages where mothers bring the raw ingredients and are taught how to process them. A revolving fund has been established in some 1500 villages through which villages maintain their own cooperatives and sell food packages (Gibbons and Griffiths 1984).

4.4 Comments

Evidence on the cost-effectiveness of approaches to improving weaning-age malnutrition is largely restricted to face-to-face education. The four projects for which both cost and suitable nutritional impact data are available were calculated to have cost-effectiveness results centred on the range $50 to $2000 per diarrhoea death averted, with considerable potential variation for any one project depending on the assumptions adopted. The studies differ in their country settings (and hence price structure), scale and approaches to cost measurement (notably whether or not voluntary labour and start-up costs are included). On the effectiveness side, some studies only measure the impact on the immediate target group and neglect consideration of siblings who may also benefit. Others fail to take into account the impact of other interventions which are frequently provided alongside weaning education and have some potential to influence nutritional status (such as the use of growth charts, provision of ORT and education on breast-feeding). Useful comparisons between the different strategies of face-to-face education of mothers are therefore difficult. In all cases we considered only the nutritionally-related diarrhoea consequences and ignored the

impact that weaning education might have as a result of reduced contamination. Untangling cause and effect and correctly attributing measured impacts is not straightforward, as the schema below (summarising the main activities and likely outcomes of the Burkina Faso programme) illustrates:



The four studies we explored in detail were all effective in reducing weaning-age malnutrition. There are other projects which also demonstrate that improvements in nutrition are possible with education, but "the great majority of nutrition education is unevaluated and apparently (and probably reasonably) assumed to be ineffective" (Hornik 1985). This may be partly because in some circumstances there is no potential for education to make any impact (resources are the primary constraint), but more frequently perhaps because of problems in the design and implementation of the projects which have limited their effectiveness. Hornik (1985) identifies the following as some of the major problems: inadequate audience reach and time of exposure; poor quality education; failure to reinforce messages; lack of complementary environmental changes; and lack of incentives for professionals. He notes that large-scale expansion of face-to-face outreach activities remains fundamentally problematic, and that mass media, if appropriately used, may provide a solution. "A serious look at media-based education can be justified."

V HYGIENE PROMOTION

5.1 Background

Most of the pathogenic organisms known to cause diarrhoea, and, in many countries, all the pathogens known to be major causes of diarrhoea, are transmitted primarily or exclusively by the faecal-oral route - either directly or via water or food (Feachem 1984). Hygiene practices clearly have potential to influence the nature and extent of such transmission. The hygiene-related behaviours known or expected to affect the transmission of enteric pathogens can be conveniently categorised as follows:

- maintaining cleanliness of person, particularly hands;
- reducing environmental faecal contamination by, for example,
  - using latrines and toilet-training children,
  - keeping latrine facilities clean,
  - minimising contact with children's faeces (appropriate clothing, careful handling of diapers and disposal of faeces, restricted playing areas for children, etc.);
- treating food and water hygienically by, inter alia, boiling water, cooking food properly and keeping food and water in clean, covered containers.

The special focus of this chapter will be on handwashing: a wide range of strategies for promoting this behaviour are theoretically feasible and many of these can readily be applied to other behaviours. Furthermore, handwashing has been one of the behaviours most clearly associated with diarrhoeal diseases.

Disease transmission via hands is difficult to prove epidemiologically. However, there is considerable circumstantial evidence, particularly in hospitals and day-care centres, to implicate hands as an important vehicle of transmission of diarrhoeal diseases. Several studies have demonstrated the feasibility of hands acting as a vehicle of transmission (Pether and Gilbert 1971) and have documented positive correlations between contamination of hands and incidence of diarrhoea (Ekanem et al. 1983; Samadi et al. 1983). Furthermore, direct studies of the impact of handwashing on bacterial counts (Sprunt et al. 1973; de

Wit and Kampelmacher 1982; Casewell and Phillips 1977) and on the incidence of diarrhoea (Steere and Mallison 1975; Sircar et al., n.d.; Khan 1982) confirm the potential for a reduction in diarrhoeal diseases from improved handwashing.

There is evidence which suggests causal relationships between several general characteristics and hygiene behaviour: literacy (Pacey 1982), general educational attainment (Levine et al. 1976) and religion (McCormack et al. 1969). However, the nature of these associations is not clear and, for various reasons, changing hygiene behaviour through these channels is unlikely to be feasible. Of greater interest to those concerned with diarrhoea control are interventions designed to change hygiene behaviour more directly: interventions such as hygiene education; the provision of facilities including latrines, soap and more convenient water sources; and the establishment of incentives or penalties. In this paper we focus principally on educational strategies, for which there is some evidence concerning efficacy and refer more briefly to other approaches.

5.2 Description of the intervention

There are at least three potentially important direct targets for hygiene education designed to reduce the incidence of diarrhoea in children under 5 years: mothers, siblings and those caring for groups of young children such as in day-care centres and hospitals. Mothers are likely to have most frequent contact with young children, to be responsible for changing diapers, toilet-training and food preparation; their hands are a potentially important vehicle for transmission of enteric diseases. Siblings, particularly those at school, have been demonstrated to be frequent introducers of diarrhoeal diseases into the home (Dingle et al. 1964). Furthermore, children in schools are an accessible audience, may be more responsive than adults to the efforts to change hygiene habits and can be an effective channel through which to influence other family members (Rohde and Sadjimin 1980). Young children in hospitals or day-care centres are exposed to potential infection from other children, and high rates of diarrhoeal disease have been documented in such settings (Weissman et al. 1974). Supervisors of these children may play an important role in facilitating the trans-

mission of disease to many children through poor personal hygiene and failure to ensure appropriate hygienic behaviour among the children.

There are two main channels through which hygiene messages can be conveyed to these targets: face-to-face education and mass media. Experience with mass media for health education suggests that it has an important role to play, though its effectiveness in promoting hygiene behaviour has not as yet been clearly demonstrated. Face-to-face hygiene education has been demonstrably successful, though admittedly on a small scale (Torun 1982; Black et al. 1981 and Khan 1982). There are some obvious cost advantages in identifying natural groupings of the educational target population (for example schoolchildren in school and mothers attending health centres or hospital) and in taking advantage of staff who already have contact with these target groups (such as teachers and health workers) to provide hygiene education.

Table 5.1 presents those approaches to hygiene education which appear to be most promising. We focus on approaches A-D, for which some data on diarrhoea impact are available, and more briefly consider the education of mothers attending health centres (E) and school children in schools (F) which appear to offer some potential both in terms of cost-effectiveness and coverage. Approaches G and H are not discussed in detail for the following reasons. The education of mothers in hospital to give birth is unlikely to be very effective because of the short period of exposure to messages, the failure to perceive hygiene as an immediate concern and the hospital location which will usually not offer relevant parallels to the home environment. Hygiene education of hospital staff, on the other hand, might substantially reduce the incidence of nosocomial enteric infections and may well be a cost-effective strategy: there is a relatively high risk of cross-infection in hospital settings (Western et al. 1982), hands have been clearly implicated as a vehicle of transmission in hospitals (Salzmann et al. 1967) and the hygiene practices of many hospital staff are poor (Albert and Condie 1981; Taylor 1978). However, since a relatively small proportion of children are hospitalised, such a strategy even if successful is unlikely to have much impact on diarrhoeal diseases in the community at large.

Table 5.1. Hygiene education delivery system and targets

	Educational delivery system		Primary education target	Primary health target
	Educators	Location		
A	Mass media	Home/community	Mothers Families	Children
B	Village health workers/TBAs etc.	Village (community groups)	Mothers	Children
C	Village health workers/TBAs etc.	Home	Mothers Families	Children
D	Day-care supervisors	Day-care centre	Day-care staff Children	Children in day-care centres and their siblings
E	Health centre staff	Health centre	Mothers attending health centre	Children of mothers attending health centre
F	School teachers	School	School children	School children and their siblings
G	Hospital staff	Hospital	Mothers in hospital for birth	Children of mothers in hospital for birth
H	Hospital staff	Hospital	Paediatric staff	Children in hospital

There are other possible approaches to hygiene promotion. Regulations concerning hygiene behaviour (though they have been imposed in some situations) are unlikely to be feasible or very effective. This is partly because they concern private behaviours which are difficult to monitor and not generally seen to threaten those outside the family. Regulations would probably be viewed as intrusive and would be evaded. It is difficult to imagine regulations working in any but small, highly-motivated and well-educated communities where their impact may, in any case, be small.

Good hygiene practices not only require awareness and motivation, but also access to relevant resources. Inadequate facilities rather than lack of information appear to be the primary determinant of poor hygiene in several documented cases. Elmendorf and Buckles (1980), in a study of a population in Guatemala, note that scarcity and inaccessibility of water influenced hygiene practices and that more frequent washing was more likely to follow from an increase in water availability than from health education messages. Torun (1982) found that improvements in domestic hygiene behaviour following an educational programme, also in Guatemala, were confined to items that did not involve additional expenditure. Koopman (1978) notes that if the relationship he found between hygiene conditions in school and diarrhoea were causal, significant reductions in disease levels could be achieved by modest investments in toilet facilities that were not so easily damaged, janitorial services and the provision of toilet paper, soap and towels. The potential costs and benefits of the provision of major amenities such as improved water supplies is discussed elsewhere (Esrey et al. 1985). In Section 5.3.7 we examine possible approaches to increasing access to one important ingredient in effective handwashing: namely soap.

5.3 Cost-effectiveness estimates

"We have found it difficult to assess clearly the true costs of programmes and few of the [studies] ... include cost data" observe Gatherer et al. (1979) in their review of health education evaluations. This is certainly true in the hygiene education field. The paucity of data is not restricted to estimates of costs but extends to inadequate project description which makes it difficult even to impute likely costs. Data on effectiveness are also scarce. The method adopted in this chapter is to concentrate on the few projects demonstrated to have an impact on diarrhoea, to extract clues from these published accounts in order to develop a plausible picture of resource use and hence costs, and then to combine this with the effectiveness data and derive individual cost-effectiveness results for each project. For major inputs (particularly wages and soap) prices were estimated using a small informal survey described in Chapter 3, Section 3.1.

5.3.1 Group education of mothers

Torun (1982) describes an education programme in Guatemala directed at mothers of young children and involving a series of nine one-hour classes (9 to 27 mothers per group) covering topics related to diarrhoea treatment, excreta disposal, handwashing, food and water hygiene and diet. Radio theatre dramatisations and discussions based on 54 large pictures were used to convey messages. Posters on which family responsibilities were recorded were issued to each participating family. It is not clear what the qualifications were of those educating the mothers or how much additional training they required, or what the transport arrangements were.

We assume that each group of, on average, 20 mothers attends 10 hygiene education sessions and that each session, together with travel and preparation time, occupies the trainer for half a day. Given further assumptions, elaborated in Table 5.2, concerning training of the educator, transport and materials used, the total cost is estimated to be $100.00 per group of mothers or $5.00 per mother.

Torun (1982) found an average difference of 14% in annual incidence of diarrhoea between children under 6 years of age whose mothers had participated in the hygiene education programme and those whose mothers had not. To convert this into the average number of episodes averted per mother educated we consider two sets of assumptions (both apply the 14% estimate to children less than 5 years). First, we assume that the programme influences incidence of diarrhoea in only one child per mother and for one year and that average annual incidence of diarrhoea in children less than 5 years is 2.2 episodes per child (Snyder and Merson 1982). In this case 0.31 (i.e. 2.2 x 0.14) episodes of diarrhoea in children under 5 years are averted per mother educated. Putting this together with cost estimates gives $16 (i.e. $5.0/0.31) per episode averted.

Second, we consider a less conservative assumption, namely that at least two children per mother educated benefit from the hygiene education programme (either concurrently or in subsequent years) and that average annual incidence of diarrhoea in children under 5 years is 3.48 per

child (from Torun (1982) for children under 6 years). In this case an estimated 0.97 (i.e. 3.48 x 0.14 x 2) diarrhoea episodes in children under 5 years are averted per mother educated, giving a cost of a little over $5 (i.e. $5.0/0.97) per episode averted.

Table 5.2. Village-based hygiene education: cost estimates

Cost components	Quantity	Price ($US 1982)	Total cost ($US 1982)
Training educators			
Salaries[1]			
. educators (10)	3 days x 10	3000 p.a.	3000 x 30/240 = 375
. professional	3 days	10 000 p.a.	10 000 x 3/240 = 125
Other (per diem, transport, materials)			= 500
Total			1000 per group of 10 educators
Educating mothers			
Salaries[1]			
. educator	5 days	3000 p.a.	3000 x 5/240 = 62.50
Transport	10 return trips	2.00 per return trip	10 x 2 = 20.00
Materials			
. take-home posters	20	0.50 each	20 x 0.50 = 10.00
. education posters	50	0.05 each[2]	50 x 0.05 = 2.50
Total			95.00 per group of 20 mothers
Total cost per group of 20 mothers			
Training of educators			5.00[3]
Education of mothers			95.00
Total			100.00

1. Assuming 240 working days per year (5 days per week; 48 working weeks per year)
2. Education posters $0.50 each but shared amongst 10 groups of mothers ($0.05 per group)
3. Assuming each educator trains at least 20 groups of mothers before she leaves the system.

This project involved education of groups. Others have focused on individual families (e.g. Sircar et al. n.d.) . Since costs per family for a given educational package can be expected to increase in inverse proportion to the number of families involved, this approach is unlikely to be cost-effective unless at least one of two conditions pertain: either the effectiveness of education in promoting change is substantially greater the smaller the groups (the evidence is conflicting but, at least with "reasonable" group sizes, there is evidence that work in groups can actually be more effective than individual sessions), or the families singled out are "high risk" and the costs of selection are themselves not too high. The next section considers an example of the "high risk" approach - intensive short-term education of families with an identified case of shigellosis.

5.3.2 Selective education of high risk families

Khan (1982) describes a study where two to four pieces of soap and one to three water pitchers (depending on family size) were provided to families of confirmed Shigella cases. These study families were urged to wash their hands following defaecation and before taking food. Each family was observed for one to two hours daily for 10 days to assess their compliance. Other families received only water pitchers or only soap. Control families were not provided with either. It is not clear from the study what manpower was required to identify confirmed cases, locate their families, persuade them to participate, educate them in the basic principles of handwashing and supervise them (as distinct from assessing compliance). Nor is there any description of the training given to educators or the transport required.

We assume that for each family with an identified Shigella case, a hygiene educator spends two hours including travel for each of 10 consecutive days visiting that family to provide soap and to provide education and supervise handwashing. Given further assumptions detailed in Table 5.3, the total cost per family is $62.50. Index cases are assumed to be detected passively (e.g. those reporting to hospital). However, there may be additional costs, not included in the estimates, associated with the identification and tracing of families, organising staff to respond rapidly and time wasted on non-cooperative families.

Table 5.3. Hygiene education of families of Shigella cases: cost estimates

Cost components	Quantity	Price ($US 1982)	Total cost ($US 1982)
Training educators			100 per educator[1]
Educating families			
Salaries			
.educator	20 hours (say 3 days)	3000 p.a.	3/240 x 3000 = 37.50
Transport	10 trips	2.00 per trip	10 x 2.00 = 20.00
Materials			
.posters	1	0.50 per poster	1 x 0.50 = 0.50
.soap	2 bars	0.25 per bar	2 x 0.25 = 0.50
Total			58.50 per family
Total cost per family educated			
Training educator			4.00[2]
Educating families			58.50
Total			62.50

1. See Table 5.2.
2. Assuming 25 families per educator.

Khan (1982) found a reduction of 84% in the secondary attack rate for Shigella in families of Shigella index cases who received intensive handwashing supervision, including provision of soap and water pitchers, over those who did not (a drop in secondary case rate from 14.2% to 2.2%). Provision of water pitchers made relatively little difference. With an average family size of 10 this converts into 1.08 cases averted (i.e. 9 x (0.142 - 0.022) and for an average family size of six, it is equivalent to 0.6 cases averted per family educated (assuming that secondary case rate and percentage reduction is independent of family size and that the impact of the programme is restricted to the period during which education and soap are provided). Combining this with cost estimates derived earlier gives a range of costs per Shigella case averted of between $58 (i.e. $62.5/1.08) and $104 (i.e. $62.5/0.6). This

is the cost per case averted irrespective of age. The cost per case averted in children under 5 years would be higher, and depends on the age distribution of Shigella cases and the percentage of family members under 5 years. If one-fifth of family members were under 5 years of age and Shigella cases were evenly distributed by age, cost per case of child shigellosis averted would rise to $300 - $500. The effectiveness results are likely to be highly dependent on the rapidity with which index cases are identified and family members contacted and educated.

This intervention was also found to reduce diarrhoea due to causes other than Shigella by 37%. Assuming an average of 1.5 children under 5 years in each Shigella index family, an annual incidence of non-Shigella diarrhoeas in children under 5 years of 2.0, and independence of diarrhoea events, then 0.08 (i.e. 10/365 x 2.0 x 1.5) episodes of non-Shigella diarrhoea would be expected to start over any given 10 day period, and 0.03 (i.e. 0.08 x 0.37) episodes of non-Shigella diarrhoea in children under 5 per index family supervised would be averted due to this intervention. Combining Shigella and non-Shigella cases averted improves cost-effectiveness results only marginally.

5.3.3 Education in day-care centres

Day-care centres are special environments where close clustering of children and staff frequently promotes the passage of micro-organisms between individuals. Outbreaks of diarrhoea resulting from person-to-person transmission have been reported in several day-care centres in the developed world. This high risk, an educational background for day-care attendants which may make them responsive to hygiene messages and an environment where relevant facilities (soap and water) are likely to be available, appears to offer a good opportunity for cost-effective hygiene education programmes.

Black et al. (1981) describe a programme designed to increase hand-washing in day-care centres and reduce diarrhoea incidence. Investigators instructed day-care employees to wash their hands after arriving at the centre, helping a child to use the toilet, changing diapers and using the toilet themselves and before handling food. Employees were also instructed to wash the children's hands when they entered the

centre, used the toilet, were diapered or prepared to eat. These practices were "rigorously monitored". It appears that this supervision continued during the entire period that diarrhoea incidence data were collected (June 1976 to April 1977) except during the period of the baseline study. It is not clear how much manpower was required to supervise activities rigorously, what additional training was provided or what transport arrangements existed.

Table 5.4. Hygiene education at day-care centres: cost estimates

Cost components	Quantity	Price ($US 1982)	Total cost ($US 1982)
Training educator			100 per educator[1]
Educating day-care staff			
Salaries	12 days	3000 p.a.	3000/240 x 12 = 150
Transport	24 trips	2.00 per trip	24 x 2 = 48
Materials			
. posters	4	0.50 each	4 x 0.50 = 2
Total			200 per centre
Total cost per centre			
Training educator			10[2]
Educating staff			200
Total			210

1. See Table 5.2.
2. Assuming 10 centres per educator.

We assume that one trained educator spends half a day every two weeks in training, reinforcing and supervising good handwashing habits by staff and children in a day-care centre (i.e. 12 full days per year) and incurs other costs detailed in Table 5.4. As with our other estimates where expenditure data are lacking, we use salary levels and prices for

inputs which are relevant to developing countries rather than to the site of this particular study (USA). The responsibility of the educator would be to draw the attention of staff to the documented evidence on cases of disease spread in such centres and to the evidence that handwashing can make an important difference, to demonstrate handwashing techniques and to supervise implementation by checking handwashing and availability of soap. The establishment of a simple diarrhoea reporting system might be a useful monitoring and motivational tool. Total costs are estimated at $210 per centre per year (Table 5.4).

Black et al. (1981) found that over a period of 10 months the incidence of diarrhoea among children 6-29 months was reduced by 48% in care centres where a programme of rigorous handwashing promotion was established compared with control centres. To convert this into average number of episodes averted per day-care centre per year, we consider two different sets of assumptions, both of which apply the 48% reduction to annual incidence. First, we assume that the equivalent of 20 children are minded each year for a year and have an average incidence of diarrhoea of 2.2 episodes per child year. In this case 21.12 (i.e 2.2 x 20 x 0.48) childhood diarrhoea episodes are averted per year per centre. Applying the estimates derived for the costs of this hygiene education programme gives a cost per case averted of about $10 (i.e. $210/21.12). If there were 50 children-years per day-care centre and average annual diarrhoea incidence were 4.2 (that found in the study by Black et al. 1981), 101 (4.2 x 50 x 0.48) episodes per year per centre would be averted, and cost per case averted would be $2 (i.e. $210/101).

5.3.4 Education in schools

Schools appear to be a potentially important venue for promoting hygiene messages so as to reduce diarrhoea in young children, and at relatively low cost. Unfortunately, although hygiene education is not an uncommon component of school syllabuses, there are few published papers which describe both the inputs required for these programmes and their impact on knowledge or behaviour, and none have been located which measure impact on diarrhoea incidence.

Gatherer et al. (1979), in their review of evaluations of school-based

health education programmes, note that short-term follow-up shows, in general, only a slight increase in knowledge and a slight change in behaviour. Nevertheless, there are several reasons for believing that hygiene education in schools has considerable potential. In the first place, handwashing is a relatively simple behaviour and the educational targets are at an age and in an environment where they are encouraged to learn and to respond to authority. Several school-based health education programmes have been demonstrably successful in conveying health information (e.g. Dwivedi et al. 1973 and Rohde and Sadjimin 1980). Furthermore, translation of knowledge and skills into handwashing behaviour, at least within school, is facilitated by the possibility of reasonably close supervision and of adequate amenities being available. It is also possible that behaviours reinforced in school may be adopted by the children in their home environment and that information and habits acquired by the children will be transmitted to their families. Rohde and Sadjimin (1980) found in their study in Indonesia that children not only grasped important points about diarrhoea, but transmitted information effectively to the community. Others have demonstrated that school-based education programmes resulted in changes in health practices in the community (Devadas 1982; Bhalerao 1981).

Admittedly, the success of these programmes may not be typical. "Health education in schools of less developed countries has frequently been very unsatisfactory" (Scotney 1976). Teachers are usually underpaid and may not be highly motivated. Additional training of teachers both on the subject matter and attractive ways to present it, and the provision of well-prepared teaching materials are probably essential. Dwivedi et al. (1973) found that simply providing teachers with new texts and instructing them to use them did make some difference to student knowledge, but the impact was significantly greater if teachers were also given a one-week training exercise, and greater still if these teachers were provided with active support from one of the sanitary inspectors from the rural health centre.

Although children at school are themselves not the 0 to 5 year olds who are of particular interest here as the primary health targets, they are an important documented source of diarrhoea for younger siblings. A study in Cleveland, USA (Dingle et al. 1964) revealed that school

children were frequent introducers of gastrointestinal disease episodes into the home. It also found that, given children of the same age, those that attended school were much more likely to introduce an episode into the family than those who did not, and that the siblings of school children had higher disease rates than children without siblings in school. Koopman (1978) has suggested that a 50% reduction in diarrhoea of school children could be expected to reduce diarrhoeal illness in their preschool siblings by 25%. He further suggests on the basis of his study in Cali, Colombia, that if all the schools he studied could reach the modest level of hygiene of the two schools with the best facilities, diarrhoea rates in school children could be reduced by 44%. If a programme of school-based hygiene education, with good supervision of hygiene together with regular provision of soap, could achieve half this reduction in school transmission (i.e. 22%), then 11% of diarrhoea in younger siblings might be prevented. If children at primary schools have, on average, 1.5 siblings under 5 years of age, and the diarrhoea incidence rate in children less than 5 years is 2.2 episodes per child per year, then a hygiene education programme in school might reduce the annual incidence of diarrhoea in children under 5 by 0.36 episodes (i.e. 1.5 x 2.2 x 0.11) per schoolchild taught.

Given the paucity of data on what might constitute an effective school hygiene education exercise, it is difficult to estimate costs. Rohde and Sadjimin (1980) established a successful programme focused on diarrhoea prevention and treatment which involved preparation of teaching materials, a two-hour lesson for teachers on their use, five half-hour lessons by teachers to pupils plus a story and homework. We assume that a professional prepares educational materials distributed to teachers at a cost of $10 per teacher and spends half a day training each group of teachers, conveying the dangers of diarrhoea, the importance of handwashing and the appropriate educational approaches to encouraging handwashing in children. The teachers would be expected to leave the workshop with a clear strategy for implementation involving, say, five half-hour sessions covering handwashing and disease, demonstrations of handwashing behaviour, stories and homework based on handwashing behaviour and facilities in the home. These sessions might be focused in a single "handwashing week" or spread out over several weeks. In either case there would be regular reminders and periodic

handwashing demonstrations and the total exercise would involve about one day's teaching. In addition, a roster for supervision of toilet areas during breaks (say two hours per day) could be established in the school to check on handwashing and soap availability.

Table 5.5. School-based hygiene education: cost estimates

Cost components	Quantity	Price ($US 1982)	Total cost ($US 1982)
Training teachers			
Salaries			
. professional	0.5 days	10 000 p.a.	0.5 x 10 000/240 = 21.00
. teachers	0.5 days x 10	3000 p.a.	10 x 0.5 x 3000/240 = 62.50
Other			
. teaching materials	10 sets	10.00 per set	10 x 10 = 100.00
. transport/ venue etc.	10	10.00 per teacher	10 x 10 = 100.00
Total			283.50 per group of 10 teachers (i.e. 28.35 per teacher)
Teaching pupils			
Salaries	1 day p.a.	3000 p.a.	3000/240 = 12.5 per class
Supervising toilet areas			
Salaries	0.25 days every day	3000 p.a.	0.25 x 3000 = 750 per school (i.e. 125 per class if 6 classes in a school)
Total costs per class			
Teacher training			28.35
Teaching pupils			12.50
Supervising toilet areas			125.00
Total			165.85

Employing assumptions detailed in Table 5.5, total costs of $166 per class of 30 are derived, giving an estimate of about $5.5 per child taught and $15 per diarrhoea episode averted in under-5s (i.e. 166 / (30 x 0.36)). If we include only the extra training of staff and the materials, and not the time teachers devoted to school teaching or supervising, then the cost per child taught would fall to $1.5 and the cost per episode averted to $4. This seems a reasonable approach to costing given that outside specialists are not being employed and teachers are in any case being paid to teach. These estimates are admittedly speculative, but do suggest that school-based strategies for reducing infant diarrhoea deserve more attention.

5.3.5 Hygiene education in health centres

Many countries deliver health education at the time of immunisation, weighing or other infant welfare or well-baby clinics or pre/post-natal check-ups. By taking advantage of a "captive" target audience to disseminate information on important health topics, costs can be minimised. There is no extra transport for staff and, where staff are underutilised, the half to one hour involved in preparation and delivery of the messages may be essentially costless to the health system. On the other hand, there are likely to be some costs for training staff (as educators rather than nurses) and for materials. There are hidden costs too: where sessions are poorly organised, incorporation of educational addresses may discourage some mothers from attending well-baby clinics at all. Furthermore, there is some doubt about the effectiveness of clinics as a venue for promoting any new health habits: the environment is often noisy and chaotic; mothers have not generally come for the education and may be unresponsive; attendance by mothers is generally not regular so developing a programme of education which allows progression and reinforcement of ideas will be difficult; and mothers whose children are all above 12-18 months old are unlikely to attend such clinics.

No convincing studies documenting the impact of hygiene education at health centres have been located. One study (Odumosu 1982) purports to demonstrate that exposure of mothers to health education at infant welfare clinics was responsible for a statistically significantly lower

level of diarrhoeal disease (2.4 episodes per child compared with 3.2). However, several aspects of the design of the study cast doubt on the validity of the results. It seems likely that, given careful planning and execution, education based in health centres could be cost-effective, but practical experience suggests that this potential has not often been tapped.

5.3.6 Mass media

No studies have been located which describe any mass media hygiene campaign and its impact on diarrhoea or on a relevant behavioural variable, such as handwashing, in sufficient detail to enable cost-effectiveness estimates to be derived. Nevertheless, there is some evidence, discussed in more detail in Chapter 3, to suggest that the mass media have been powerful tools for promoting health messages and that where there are reasonably large populations with good access to media and a common language, the use of mass media may well be a cost-effective strategy for encouraging improved hygiene.

Promotion of handwashing may be particularly suited to a mass media approach for several reasons. Firstly, the behaviours which a handwashing promotional campaign is attempting to instil are well defined and universally applicable: to wash hands thoroughly, preferably with soap and at least after defaecation and before eating or preparing food. There are some questions which deserve closer scrutiny: the relative effectiveness of soap, traditional soaps, water alone, other cleansing strategies, the consequences of recycling washing water and the importance of drying hands. Answers to these may suggest that some adaptation to local circumstances is desirable, but, on the whole, it seems likely that the same message can be given the wide airing that the use of mass media usually implies. Secondly, there appear to be many areas where physical and financial access to relevant resources (soap and water) is not the major problem and where, consequently, education has a major potential role to play. Thirdly, soap is a widely advertised product in the third world, and there would appear to be good opportunities for capitalising on this and linking specific hygiene messages to soap promotion. Finally, the educational target population is likely to be a rather larger proportion of the total population than

that for, say, breast-feeding and weaning promotion, and the costs per target exposed consequently lower.

5.3.7 Increasing access to soap

The importance for disease control of washing hands with soap has been illustrated by several studies (e.g. Khan 1982). The extent to which lack of access to soap or the price of soap discourages its use is not clear. Soap is a widely marketed and heavily promoted commodity in the third world and it appears that soap is purchased even by many of the poorer households. Nevertheless, there may be an argument for increasing soap accessibility in some circumstances. Khan (1982), for example, found that providing soap together with handwashing advocacy had a significantly greater impact on Shigella transmission than did handwashing supervision with provision of only pitchers for water. There is a dearth of descriptions of efforts to make soap more widely available and of data on costs or effects of these efforts. We outline briefly below some of the approaches which could be considered.

If industry is unaware of the potential demand for soap or of the existence of more efficient soap-making technologies, governments may be able to promote production or lower prices by alerting industry to such commercial opportunities. Since the soap industry is highly developed this situation is unlikely; potential for making profit by tapping latent demand or employing alternative technologies would be detected first by industry rather than government. An alternative approach is to subsidise soap production or distribution either directly or indirectly (by establishing price ceilings or guaranteeing government purchase of soap). Governments could even establish their own soap manufacturing industry where soap prices could be readily controlled. Which of these options is most appropriate depends on the nature of the soap-making industry, particularly with respect to economies of scale, and the efficiency of government production and marketing. Economic literature would suggest that unless there are "imperfections" in the market (such as a monopoly structure leading to sub-optimal production levels and relatively high prices) the establishment of government production facilities or price regulation are probably less attractive options than some form of subsidy.

An alternative approach is to by-pass commercial manufacture and to encourage small-scale, community-based production. At this level, provision of information and education in soap-making techniques could be useful. Ignorance or lack of skills might well account for a failure to establish local soap production. But time or finances might also be constraints, or ingredients might not be locally available. Before embarking on a programme to provide such education it would be necessary, at the very least, to confirm that ingredients can be obtained, and that the value of ingredients and time to the community is less than the cost of commercially available soaps. To stimulate home production it may also be necessary, initially, to subsidise the cost of ingredients.

The cost to government of these strategies will clearly depend on the degree to which it wishes to increase soap consumption. Teaching techniques of soap-making may only require a day or two's tuition for a group of families - at a cost of around $1.00 per family (assuming a tutor on $3000 p.a. spends the equivalent of two days teaching a group of 25 how to make soap). If soap, costing say 20 cents a bar to manufacture, were provided free, and each family were allowed a quota of one bar per week, the cost would be $10.00 per family per year excluding administration costs for rationing.

Predicting the effectiveness of such strategies is difficult. Greenough (1985) suggests that "if serious attention were now given to soap, its production, distribution and use in targeted settings, enormous leaps in control of not only diarrhoea but also other communicable diseases might occur". Intuition supports this claim; evidence is weak. Studies of the impact of changes in the availability of soap, unaccompanied by education, or of the effect on demand of lowering the price of soap, have not been located. If demand is unresponsive to price, even quite a dramatic change in price may have little impact on purchase of soap. Furthermore, even if there is a growth in sales as a consequence of a fall in price, it may not be reflected in an increase in handwashing. There are many communities where soap is available and purchased but is used for washing clothes and periodic bathing rather than regular handwashing. Reducing the price of soap may simply give rise to cleaner shirts. These observations suggest the advisability of linking consumer education concerning handwashing with pricing and production strategies

so as to maximise impact. This may be done in several ways. For example, education on methods of soap production could be introduced as part of a community-based handwashing promotion campaign; commercial producers could be encouraged to collaborate by promoting handwashing in their product advertisements, perhaps using a common logo or jingle; limited supplies of soap could be provided at a subsidised price to those attending hygiene education sessions.

5.4 Comments

Analysis of the three studies for which data on diarrhoea impact is available gives a range of cost-effectiveness estimates for hygiene education of under $20 per childhood diarrhoea case averted for village-based group education and supervision of day-care centres, and $300 - $500 for individual education of Shigella index families. Though hard evidence concerning effectiveness is lacking, education through schools and mass media channels appear to be two further options worth considering. A school education programme could cost less than $1.5 per child taught and might avert diarrhoea in siblings for under $5 per case averted. In some circumstances a quite substantial mass media campaign could be mounted for less than $0.50 per child whose mother is exposed to the mass media per year. Both strategies appear to have considerable potential to influence diarrhoea disease rates in a cost-effective fashion. The likely impact on handwashing and diarrhoea incidence of efforts to make soap more accessible is uncertain and deserves more research. "It is quite astonishing that so little attention has been paid to soap" (Greenough 1985).

The studies reporting impact of hygiene education programmes on diarrhoea incidence, while not immune from some of the methodological weaknesses outlined in Blum and Feachem (1983), are reasonably convincing. If anything, impact may tend to be underestimated due to the failure to measure changes over the longer term or beyond the immediate target group. (Torun's results support the existence of this diffusion effect.) Our assumptions in this regard have been conservative. Further study is warranted on the nature of "decay" (loss of information over time) and its opposite - the "sleeper" effect (delayed impact of educational messages) - in educational programmes of this sort.

Without more detail about the individual studies, it is impossible to know whether the relevant inputs have been accurately identified for costing purposes. In particular, the nature and extent of pre-implementation planning and research is not described in the original articles and no allowance has been made for such activities in the costings. In some studies there is ambiguity as to what aspects of a general programme could be associated with the measured change in diarrhoea incidence. For example, could the changes in the Guatemalan study (Torun 1982) be attributed solely to the education of mothers rather than work with schools and husbands? Even assuming that the inputs and outcomes have been accurately measured, cost-effectiveness comparisons between alternative strategies should be made with caution, particularly as the unit of effectiveness - diarrhoea case averted - is not strictly comparable between strategies. A focus on Shigella index families, for example, will tend to prevent diarrhoea of more serious nature than that averted by other approaches.

Even if the results from these particular studies are accurate and can be interpreted with confidence, how reasonable is it to generalise from them in predicting the success that hygiene educational programmes are likely to enjoy? Some attempt has been made in this paper to consider the range of feasible strategies and to use data relevant to developing countries. Where analysis in this paper required choice from a range of possibilities not defined by the studies themselves (for instance, prices of inputs, size of family, incidence of diarrhoea), the figure generally selected was a likely average for developing countries rather than that expected for the particular site. For example, salaries, which contribute significantly to total costs, were based on results from a survey of a wide range of developing countries. This was done in order to maximise the relevance of the cost-effectiveness estimates beyond the location of the studies themselves. The results of the salary survey (described in Chapter 3, Section 3.1) indicate that the cost estimates could range from between a tenth to double the estimates derived here, depending on the country in which the project were implemented. There is a variety of factors within any one strategy which are likely to influence cost-effectiveness and for most strategies only a single example is considered. In addition to the small number of studies, which limits confidence in the predictive power of the result,

the selection may be biased: unsuccessful projects are probably less likely to be reported; and the studies are all relatively small, closely supervised, experimental efforts from which it may be difficult to draw useful conclusions concerning more substantial national programmes.

Historical postscript

Nineteenth century Britain provides some insights into the potential role that soap promotion and hygiene education could play in reducing disease. Cost appeared to be a major deterrent to soap use in Victorian Britain. Until 1853 an excise was levied on soap made in the United Kingdom: at 3 pence, the tax was greater than the cost of the soap itself (Friedman 1948). Apparently as a consequence of removing the tax, consumption of soap per capita doubled between 1841 and 1861 (Wright 1960). Soap appears to have been valued very highly in late Victorian Britain. In some working class budgets, as much was spent on soap and washing materials as on fuel or tea and milk (Wohl 1983). This was no doubt, at least in part, a consequence of the vigorous educational efforts of groups such as the Ladies Sanitary Association for the Diffusion of Sanitary Knowledge, founded in 1857. Those sanitary societies published and distributed pamphlets (1.5 million between 1857 and 1881) and "sent a veritable army of women workers to the homes of the poor". In Manchester, for example, by the end of the century health visitors were making almost 36 000 house visits. These workers were well versed in the rudiments of domestic hygiene and, according to Wohl, "did much to bring the gospel of soap and water into the homes of the masses". In addition they distributed cleaning materials. In Aberdeen in 1880, the Ladies Sanitary Association distributed 1228 supplies of soap, 203 of washing powder and 30 bottles of disinfectant. Although it is impossible to document the impact of these efforts on hygiene behaviour, the decline in typhus deaths before sweeping sanitary improvements occurred suggests that new standards of personal hygiene did appear shortly after the mid-century (Wohl 1983).

VI DISCUSSION AND RECOMMENDATIONS

6.1 Results

The cost-effectiveness results of the six interventions discussed in this paper, together with results from ORT programmes and other health interventions are summarised in Table 6.1. Comparisons, particularly with "other health programmes", are fraught with difficulties; the data base is very limited and, in the case of "other health programmes", a wide spectrum of health activities is covered: malaria control, water and sanitation, nutritional interventions and general primary health care projects. Nevertheless we present these figures to give a rough idea of values that have been derived from other health programmes.

The results indicate that none of the interventions can, on present evidence, be dismissed as clearly inefficient approaches to reducing childhood mortality. None, except for cholera vaccination, have upper estimates of cost per death averted higher than the maximum costs for ORT or other health interventions, and the median results for both measles and rotavirus vaccination are no higher than that for ORT. Furthermore, several of the six interventions reduce mortality from causes other than diarrhoea (see Section 6.4), and taking account of these additional mortality effects would further reduce estimates of cost per child death averted. There are no diarrhoea mortality data for hygiene interventions. With the exception of weaning education designed to reduce weaning age malnutrition, the six interventions also play a role in reducing diarrhoea morbidity. Measles and rotavirus vaccinations, and breast-feeding and hygiene promotion can all be implemented for probably less than $50 per diarrhoea episode averted.

While measles and rotavirus vaccination appear to be particularly promising, the results do not suggest that any one intervention is unambiguously superior to the others in terms of efficiency in reducing either diarrhoea episodes or diarrhoea deaths. The range of results overlap, and the number of observations from which medians are derived is generally too small for confident generalisations. This is true even when focusing on particular strategies which appear to be the most cost-effective within any one kind of intervention.

Table 6.1. Cost-effectiveness of diarrhoea prevention and other health interventions

Intervention	Cost ($US 1982) per diarrhoea episode averted in under-5s range (and median)		Cost ($US 1982) per diarrhoea death averted in under-5s[1] range (and median)	
Measles vaccination	3 - 60	(7)	66 - 1156	(140)
Rotavirus vaccination	3 - 30	(5)	141 - 1401	(220)
Cholera vaccination (in Bangladesh)	90 - 1450	(174)	1075 - 16710	(2000)
Breast-feeding promotion	10 - 75	(45)	400 - 10750	(1000)
Improved weaning practices	-		50 - 2000	(1070)
Hygiene promotion	5 - 500	(10)	-	
ORT	-		100 - 8000	(220)[2]
Other health programmes in developing countries	-		100 - 12000	(2000)[3]

1. For all the interventions except "other health programmes" this refers to death from diarrhoea.

2. Based on data from 13 projects summarised in Shepard and Brenzel (1985) and converted into $US 1982 assuming an inflation rate of 10% per year.

3. Based on data summarised in Walsh and Warren (1979) and Cochrane and Zachariah (1983) and converted to $US 1982 assuming an inflation rate of 10% per year.

In order to draw out more from these results than the summary data allow, and to put the results into perspective, we explore a number of issues in the following sections. Firstly, we consider the major sources of variation in cost-effectiveness for any given intervention: what factors need to be considered in designing the most cost-effective approach to diarrhoeal diseases control (Section 6.2). Achieving broad coverage may be an important objective for many programmes, and not one explicitly considered in our cost-effectiveness analysis. In Section 6.3, we examine some of the major strategies advocated in previous

sections, and identify the natural boundaries to their overall potential impact given the current pattern of access to and usage of different services and facilities. Prevention of diarrhoea is not the only effect that most interventions have, and there are other costs involved apart from those borne by the implementing agency. Cost-effectiveness, expressed in terms of cost per diarrhoea episode or death averted, is clearly, therefore, not always an accurate indicator of the relative overall efficiency of alternative strategies. Section 6.4 identifies some of these other costs and benefits and notes some of the methodologies for accommodating them in indicators to guide decision-making. In Section 6.5 we note that efficiency is not the only concern of decision-makers, and briefly draw attention to the question of equity, an issue related to, but distinct from, coverage. The implication of our analysis in most of this paper is that the options being considered are mutually exclusive: either breast-feeding promotion or improved hygiene, for example. In Section 6.6, we introduce the more realistic scenario of joint provision and explore some of the implications for cost-effectiveness. We conclude, in Section 6.7, with the identification of the few specific recommendations for action about which it is possible to generalise, and some suggestions for further research.

6.2 Factors influencing cost-effectiveness

Some of the variation in cost-effectiveness estimates for any given intervention may be due to inaccuracies in the data. In earlier chapters we have discussed some of the key methodological problems of studies measuring impact (e.g. confounding and the lack of controls, seasonality, identification of diarrhoea morbidity and mortality, impact on non-target groups) and costs (e.g. failure to specify resource requirements accurately and to include all relevant costs, a particular problem when estimates are culled from inadequate project descriptions). These may give rise to spurious differences in cost-effectiveness between individual projects, although there is no reason to believe that they have worked to bias results in any particular direction or that they are more or less common for different interventions.

Even if both costs and effects had been consistently and accurately

measured, considerable variation would probably remain. It is unlikely that universal recommendations concerning choices between these interventions could be made simply by improving the quality of data. Some of the variation, at least for interventions whose costs are based on actual expenditure data, reflects differences between countries in the price of inputs in relation to the official exchange rate. The high estimate of additional vaccination costs based on data from Ghana, for example (Tables 1.6, 1.7 and 1.8) is largely due to a highly overvalued exchange rate (Creese 1986). Differences between countries in rates of taxation or subsidy, degree of competition, market demand and supply conditions for inputs can also contribute to differences in the ratio of the input price to the official exchange rate (Barlow and Grobar 1986). This source of variation may be important for donors who finance programmes with foreign exchange and are deciding on the countries to which external assistance might most effectively be provided. However, it obscures conclusions about relative technical efficiency which is what is generally relevant to domestic governments and their choices. Our approach for interventions without expenditure data (e.g. breast-feeding and improved weaning promotion), of building up estimates from inputs and prices, avoids the problem of dealing with price/exchange rate relationships affecting comparisons and makes it relatively simple to explore how price differences influence cost-effectiveness.

Much of the variation in cost-effectiveness can be attributed to real differences in efficiency (and not simply to data inconsistencies or price differentials). These are the sources of variation which it is important to understand in order to predict which interventions or strategies are likely to be appropriate in a given country and to design them optimally. Unfortunately, the data are woefully inadequate for modelling the way in which cost-effectiveness changes with respect to most key variables, and specification of quantitative relationships is impossible. Different approaches can be used to explore factors likely to influence effectiveness. One is to trace the causal links between intervention and health impact, focusing on risk factors. An alternative is to take a "cross-sectional" perspective. Tugwell et al. (1985), for example, suggest an analysis which focuses on five factors influencing community effectiveness: efficacy, diagnostic accuracy, health provider compliance, patient compliance and coverage. Such an

approach can be helpful in categorising sources of variation in effectiveness for some interventions. However, this breakdown has a distinctly clinical flavour and is difficult to use for preventive strategies, particularly education. We propose here a broad analytical framework which accommodates consideration of cost as well as effectiveness issues and can be readily applied to educational interventions. For a given set of prices, the factors influencing cost-effectiveness can be categorised as:

- characteristics of the educational and health targets;
- the extent of existing infrastructure;
- technical features of the intervention itself;
- the scale of the intervention.

6.2.1 Target characteristics

Prevalence of the risk factor

The nature of both the direct target (usually mothers) and the health target (some subgroup of children under 5 years of age) can have important implications for cost-effectiveness. The prevalence of the risk factor (failure to breast-feed or wash hands, poor nutritional status in children and high incidence of measles, rotavirus or cholera) is clearly important in deciding what type of intervention might be the most efficient in preventing diarrhoea. For the measles and rotavirus vaccination, our calculations of cost-effectiveness were based on a single plausible pattern of risk by age (expressed in terms of measles or rotavirus diarrhoea cases as a percentage of all diarrhoea cases) derived from available studies, which did not show significant variation (Feachem and Koblinsky 1983). Cholera is very different, with incidence rates varying greatly from country to country. Our effectiveness calculations are based on the very particular case of Bangladesh where cholera is endemic, with an incidence rate of about 10 per 1000 per year in under 5 year olds (de Zoysa and Feachem 1985a). For most other countries, where cholera incidence is lower, the cost-effectiveness results are likely to make cholera vaccination appear even less favourable than our estimates suggest.

Breast-feeding rates vary considerably between different countries and

between groups within countries. In general, breast-feeding is much more common in Asia and Africa than in Latin America. Countries such as Costa Rica, Panama, Mexico and Malaysia have particularly low breast-feeding rates (Notzen 1984). In Africa and Asia, rich urban mothers tend to breast-feed least. Our calculations are based on three plausible patterns of breast-feeding mode, simplified by Feachem and Koblinsky (1984) from data gathered in a WHO feeding study (WHO 1981).

In our analysis of the cost-effectiveness of weaning education, the examples we explored (those which had both cost and effectiveness data) mostly had pre-intervention malnutrition levels of around 35%. One report suggests that the proportion of 6-60 month olds who reach less than 75% weight-for-age varies from 35% to 50% in developing countries (Israel et al. 1981). In areas where over half the infants are under-nourished, the estimated impact on diarrhoea mortality would be some 30% higher than our estimate (all other things being equal).

The data for hygiene education are not adequate for considering the potential impact of changes in the prevalence of unhygienic behaviour on the estimates.

Other target characteristics

Prevalence of the risk factor in the population is not the only characteristic of the target population which will influence cost-effectiveness: accessibility and responsiveness of the target to the intervention, and the strength of the association between the risk factor and diarrhoeal diseases are also important. Consideration of these factors leads to the recommendation that mothers should be the primary target of most of the educational strategies and that the focus should be on populations with sufficient resources to be able to act.

Problems with selection of targets

Criteria of accessibility, responsiveness and being at risk as the basis for selection should, however, be used with caution. Firstly, the criteria are not necessarily unrelated and may indeed be negatively correlated. For example, populations which are least accessible may

well be populations with a higher prevalence of the risk factor and a higher diarrhoea mortality rate. Similarly, educational targets which have least potential or motivation for change (such as those with fewest resources or low levels of education) are often those whose children are most at risk.

Secondly, the process of being selective may incur costs. Identifying high risk groups and targeting messages specifically to them can be costly, as the example of hygiene education of families with an index Shigella case illustrated (Chapter 5). Unless those at risk can be readily and inexpensively identified (for example, by using children as scouts for malnourished babies (Feuerstein 1981)) and the intervention can be economically delivered to them, the cost of selection may outweigh the gains from having a smaller number to educate. For example, to deal with families of Shigella cases selectively and effectively requires rapid marshalling of educational resources and intensive small-group education, both of which have significant cost implications. Indeed, because the cost of education through mass media and to some degree with groups does not respond directly to changes in numbers educated, there may be little to be gained from being highly selective.

Thirdly, there is considerable scope with some interventions for adapting educational messages and approaches to the circumstances of the particular population, and this may be a more efficient approach than selecting populations on the basis of their likely responsiveness to recommendations on some "ideal" behaviour. Finally, selectivity, whatever its basis, is likely to have implications for equity, an issue discussed further in Section 6.5.

6.2.2 Infrastructure characteristics

The nature of the existing infrastructure can be an important influence on cost-effectiveness for two reasons. Firstly, the existence of other activities may reinforce or moderate the impact of a programme. For example, weaning education may be particularly successful when attached to supplementary feeding programmes. Secondly, the more resources that are already in place and can be deployed, the cheaper it will be to mount any new programme. Because of the major contribution that wages

make to the cost of most of the interventions, particularly those involving face-to-face education, the potential for using available manpower already in contact with the target group deserves to be fully explored. In addition to a variety of health personnel (hospital and health centre staff, village health workers, traditional birth attendants and immunisation, malaria and family planning workers) there are others such as teachers, religious leaders and agricultural workers who may be effectively utilised. Factors to consider in identifying potential educators from existing manpower include the proportion of the target they currently serve, the similarity of their current and projected tasks, their willingness to assume additional responsibilities and the likelihood of their effectiveness (Heaver 1984).

6.2.3 Intervention characteristics

Technical aspects of the design of a strategy may clearly have important implications for cost-effectiveness. In previous chapters we discussed some of these in more detail, particularly with reference to education. Effectiveness is influenced by several dimensions of an educational programme: the choice of media; message design; style of presentation (one reason for the success of the Moroccan programme may well have been the dynamic approach of the teachers and good use of demonstration materials (Gilmore et al. 1980)); location and timing of sessions; incentives for teachers to teach and teach well, and for educational targets to attend, learn and act; and even, perhaps, the style of dress of the educator (Burghart 1982). Each of these will have an impact at one or more stages in the educational process which can be crudely conceptualised as involving exposure, understanding and action leading to changes in health status. The message, for example, should be designed so that it captures interest, is simple and specific, uses familiar language to facilitate understanding and recommends new behaviours which are both feasible in time and financial terms and the adoption of which will significantly reduce the risk of diarrhoea. Some consensus is emerging as to characteristics of educational activities that appear to be particularly important determinants of effectiveness (Hornik 1985; Manoff 1985; Gatherer et al. 1979) but surprisingly little attention has been paid to considering these issues in the light of budgetary constraints. In most cases there is some trade-off between

effectiveness and costs: the longer the exposure to messages or the more appropriately designed the messages (and the more background research required) or the more incentives provided, the more effective and the more costly the education will be.

There are remarkably few data which describe more precisely the nature of these trade-offs or even the links between inputs and outputs so that optimum levels of investment can be determined; there appears to be considerable scope for more research in this area. For example, the relationship between intensity or length of educational exposure and propensity to learn or adopt new practices is poorly described. Manoff (1985) has "examined scores of (health education mass media) campaigns without uncovering one that made a determined effort to analyse the media's audience reach, frequency and continuity or to evaluate the implications of such intelligence on the outcome of the campaign". There is very little evidence concerning the relationship between the thoroughness of initial research and the effectiveness of educational programmes. Experience suggests that returns on research prior to implementation can be high and that more research is justified the less the opportunity for subsequent modification (e.g. with mass media), the larger the programme and the more radical the behaviour change being considered.

6.2.4 Scale

Scale can be an important determinant of cost-effectiveness for some interventions. Strategies involving mass media, for example, require high initial investments but minimal extra cost for each additional person exposed to the message: cost-effectiveness is consequently likely to increase with the size of the population exposed. Vaccination programmes also exhibit increasing returns to scale (Creese et al. 1982) though there are good reasons for expecting that beyond a certain point the costs of reaching the more remote communities or less willing individuals would reverse this pattern (Mead Over 1986).

Because the cost-effectiveness of any one strategy and the priority ordering of strategies with respect to cost-effectiveness can change with size, the choice between different interventions or strategies may

well depend on coverage objectives or budgetary constraints. For example, if limited funds are available, the most cost-effective option for reducing diarrhoea may well be to promote changes in hospital routine for women giving birth. This requires relatively little investment in order to achieve good results. The same small investment devoted to, say, a mass media campaign may be largely wasted, absorbed by central administration or preliminary research with little remaining for implementation. A larger budget could make mass media a more competitive option. Similar arguments apply if coverage objectives are fixed.

In some cases there are natural boundaries to the coverage that can be achieved with a particular strategy, boundaries delineated by the proportion of the population that could be exposed if the strategy were fully exploited. Since high coverage is likely to be an important objective in most programmes, we consider in the next section the coverage potential and limitations of key strategies.

6.3 Coverage

While community-based activities can in theory be targeted at the whole population, most other strategies are more circumscribed. Those strategies that rely on health facilities, for example, will in general only reach those mothers who utilise these facilities. Data on attendance at health centres by mothers with young children is patchy. Figures on the percentage of mothers or mothers-to-be receiving pre-/post-natal care provide some indication and suggest that maternity care reaches a substantial proportion of women (more than 80% pre-natal) in China, Cuba, The Gambia, Lesotho, Mauritius, Trinidad and Tobago, and Vietnam, but coverage is poor in Honduras, Nigeria and Uruguay (WHO 1985). In some countries even access, a basic prerequisite to use, is low. In Zaire, for example, it is estimated that only 25% of the population have access to the formal health care system (Israel et al. 1981).

Hospital-based activities for breast-feeding promotion are unlikely to have much impact beyond those mothers hospitalised for childbirth, a relatively high proportion in a number of Latin American and Caribbean countries (e.g. Chile, Costa Rica, Cuba, Mexico City and Panama, all with more than 85% of deliveries in institutions), but low in many Asian

and African countries (e.g.Bangladesh, Benin, Burma, Egypt, The Gambia, India, Indonesia, Nepal, Pakistan, the Philippines and Sudan, all with rates under 30%) (WHO 1985).

The impact of facilities for working women will be limited to those women employed in the formal sector. In many countries the proportion of women with young children who work away from home is quite high, but many of these (e.g. 50% in India (Hamilton et al. 1981)) work in the informal sector which remains unaffected by legislation.

The primary school system is an obvious candidate to be considered in any national effort which aims at behaviour change. "In almost every village of the developing world there are primary schools. The government budget for education is usually two to three times that for health" (Cole-King 1983). Schooling for at least five years is compulsory in most developing countries (126 out of 158) and enrolment figures for children aged 6-11 years average 63% (Africa), 69% (Asia), up to 81% (Latin America), with a developing country average of 68% (UNESCO 1984). Enrolment is no guarantee of regular attendance and not all children under 5 years old have siblings in the 6-11 year old age group. Nevertheless, these figures suggest that the health of a considerable proportion of young children could be influenced by a primary school education programme.

Day-care centres are more common in affluent societies than elsewhere, but their potential as a channel for, say, hygiene education in developing countries should not be underestimated. In recent years a number of countries have enacted legislation requiring the establishment of nurseries in enterprises that employ more than a specified minimum of women (often 50 or 100). APHA (1984) lists 23 developing countries which have such provisions. Although the establishment of nurseries is not guaranteed by the enactment of legislation, and the regulations cannot be applied to the non-formal sector, these figures do suggest that day-care facilities may become increasingly important in developing countries. In some cases the government itself funds the establishment of nurseries, for example in Costa Rica (58), in El Salvador (18) and in Honduras (9). Some countries, for example Brazil, are experimenting with regulated but less institutionalised child-care facilities where

mothers (given some basic training and supervision) are licensed to look after a small number of children (Mothers and Children 1984).

Mass media impact will be limited by the level of direct access to the media. In developing countries, television coverage is generally low (Turkey is one exception), but may rise rapidly due to satellite technology. Radio ownership is considerably more common: four times as many radios as televisions are licensed in the third world (UNESCO 1984). Latin American countries (with on average 324 licensed radio receivers per 1000 population) have higher radio ownership rates than in Asia (103/1000) or Africa (87/1000) (UNESCO 1984). Countries where official radio ownership rates are particularly low include Bangladesh, India, Lesotho, Malawi, Uganda and Zambia, all with less than 30 radios per 1000 population (Commonwealth Secretariat 1982). Of course these statistics only indicate the broad parameters of the potential of the mass media: the existence of different language groups, the tendency for husbands to monopolise use of the radio and the sharing of radios within communities are all factors which could influence exposure.

6.4 Other costs and benefits

This document has been concerned with calculating cost-effectiveness and exploring factors which influence it, with a view to using these results to guide decision-makers. The analysis is, however, a partial one, concentrating as it does on provider costs, not costs to the "consumer", and on one specific set of outcomes - diarrhoea morbidity and mortality in children under 5 years. For those decision-makers concerned only with the funds they require to implement a programme and whose achievements are measured solely in terms of reduction in diarrhoea among young children, cost per diarrhoea episode or death averted may be the only indicators of relative merit they require. Most decision-makers have wider perspectives and will value other dimensions of a project's resource demands or impact. Indeed, it is in the interests of society as a whole that all the ramifications of an intervention be taken into account, otherwise optimal resource allocation is unlikely to result.

The interventions discussed in this document differ rather dramatically in the scale and scope of the costs and benefits not captured by the

measure of provider cost per diarrhoea episode or death averted. We explore some of them briefly here. Firstly, we discuss differences in the nature of the diarrhoea events which the various interventions address. We then consider differences in other effects: some of them non-diarrhoea health effects, others outside the health domain. Finally, we note some of the differences in impact of the interventions on privately incurred costs.

6.4.1 Differences in diarrhoea events

Diarrhoea episodes are not all alike. Cholera and rotavirus diarrhoeas, for example, appear to be of above average severity (de Zoysa and Feachem 1985a) and measles-associated diarrhoeas have been found to be of significantly longer duration than other diarrhoeas (Koster et al. 1981). Also, the distribution of diarrhoea prevention by age varies between interventions and may have health consequences. There is evidence to suggest that the younger the infant the more serious the long-term consequences of an episode of diarrhoea of any given immediate severity. The diarrhoeas prevented through a breast-feeding campaign will be almost entirely in the first year of life; those prevented through rotavirus vaccination will be mainly in the first two years of life whereas the other interventions considered here will have an impact throughout early childhood. Even mortality measures may not be truly comparable. Firstly, the age distribution of diarrhoea deaths prevented is different for the interventions. This could be significant for two reasons: firstly, the value placed on the life saved may depend either on the age at death itself (Are 4 year olds valued more than 4 month olds?) or on the length of life saved by the average death prevented. Secondly, the "quality" of the lives saved may differ between the interventions for reasons other than those related to age. For example, it has been suggested that measles-associated diarrhoea selectively kills the weakest whose chances of survival, even if they avoid measles, are low (O'Donovan 1971). One study did indeed find that differences in the overall survival rate between those vaccinated and those not vaccinated was very small (Kasongo Project Team 1981). More recent investigations have, however, suggested that rather than being a mechanism of natural selection taking the weakest children, measles aggravates the condition of many children leading to delayed excess mortality (Aaby 1984).

The interventions are different in their impact on diarrhoea mortality and morbidity in the over 5 year age group. Weaning and breast-feeding promotion and rotavirus and measles vaccination will have little or no impact on diarrhoea in those over 5 years of age. Cholera vaccinations and hygiene education, on the other hand, may have a significant impact on diarrhoea in older age groups, an added bonus not captured by the measures of effectiveness used in this paper.

6.4.2 Non-diarrhoea effects

The interventions differ in their impact on health variables apart from diarrhoea. Some of the interventions are specifically targeted at diarrhoea (e.g. rotavirus and cholera vaccinations). Others have broader health effects: hygiene education on skin disease, hepatitis A and intestinal worms; improved weaning practices on susceptibility to morbidity and mortality from causes other than diarrhoea and long term intellectual development (Selowsky 1981); measles vaccination on measles and on complications of measles other than diarrhoea; and breast-feeding on morbidity and mortality from a range of causes (Winikoff and Baer 1980). Breast-feeding also prolongs amenorrhoea and promotes child-spacing and is associated, with varying degrees of confidence, with other health benefits including avoiding dental caries, promoting normal face and speech development, avoiding infant obesity and promoting greater intellectual ability (Population Reports 1981). Mata et al. (1982) attributed to breast-feeding interventions a significant reduction in the rate at which normal-term infants were abandoned by their mothers.

In some cases these positive health consequences must be set against negative health spin-offs. Fever or local reactions at the site of vaccination are not uncommon, and the injection itself may cause immediate discomfort and pain. More serious post-vaccination complications can occasionally arise. With measles vaccination, encephalitis and encephalopathy occur in one per million doses and subacute sclerosing panencephalitis in 0.5-1.1 per million doses. These rates are respectively 1000 and 10-20 times less than the rates of these complications in naturally acquired measles (Willems and Sanders 1981).

There are also consequences beyond the health sphere. Some of these are relatively minor, for example the increased confidence of mothers in handling their babies as a result of changes in hospital routine (McBryde 1951); others, such as the time and income advantages to working women of having child-minding facilities, are quite substantial. Educational interventions have been said to have important benefits resulting from involvement in the educational process per se. Gilmore et al. (1980) note that participation in the Moroccan nutritional programme appeared to be a key factor in providing women with an opportunity to share in the benefits of broader community life: more women began seeking prompt treatment for complaints, following advice better and giving birth in hospitals. Indeed, some have argued that education should be valued in its own right even if it does not stimulate any change. "To the receptive member of the community, effective education means the provision of information on which he or she can make whatever decision they choose. It is therefore dangerous and too limiting to consider that the only valuable health education is that which can be measured in terms of behavioural change" (Gatherer et al. 1979).

6.4.3 Privately incurred costs

Just as it is possible to identify benefits in addition to those reflected in diarrhoea statistics, so there are costs incurred by society which are not encapsulated in the cost measure we have used. Individuals, as well as implementing agencies, bear costs. Simply to expose themselves to educational interventions, for example, individuals may incur costs in time and travel to attend sessions, or in the form of batteries to operate radios where mains power is unavailable. The behaviours that these interventions promote frequently imply further costs: forfeited wages or time and fees for vaccination, purchase of soap and perhaps water for handwashing, and purchase of more, or more expensive, weaning foods and time to prepare them. These costs are seldom measured, though it is clear from some studies (such as that by Zeitlin (1981), that they can be substantial. With breast-feeding there are financial benefits as well as costs to families. The cost of infant formula over a six month period, assuming instructions to be correctly followed, was estimated for four countries to be of the order

of $50-$140, representing between 15% and 140% of per capita annual GNP (WHO 1981). Adding the cost of bottles and fuel for sterilisation suggests a total cost for proper feeding with breast-milk substitutes of some $200 - $300 for the first year of life (Population Reports 1981). Bottle-feeding can also be more time-consuming than breast-feeding (Greiner et al. 1979). However, the value of that time is difficult to assess. Responsibility for bottle-feeding can be assumed by someone other than the mother, in particular by a lower- or non-wage earner, thus permitting the mother to go out to work. The private cost of breast-feeding may be the entire forfeited wage of the mother.

In some cases it is extremely difficult to predict the ramifications of interventions and the incidence of costs and benefits, particularly with those interventions involving legislation. For example, legislation against breast-milk substitutes imposes costs on manufacturers with the loss of lucrative markets or the imposition of penalties for breaking the law. If these costs are substantial, and the manufacturers influential, governments may be taking political risks in implementing legislation. Where industries are asked to shoulder the costs of facilitating breast-feeding by working women, they may well shift some of these costs to women. In Malaysia, it has been reported that married women are not hired in the electronics industry and are required to resign on marriage so that the firm avoids payment of maternity benefits required by law (Lim 1978). Other companies keep the recruitment of women just below the level needed for provision of day-care facilities (Manciaux and Pechevis 1979). Even when the consequences of interventions are known, it may not be obvious whether to interpret them as costs or benefits. For example, advertising of breast-milk substitutes could be seen as an exercise in misinformation and distortion of consumer preferences. To the extent that this is true, control of advertising is a benefit. On the other hand, it could be argued that such restrictions impose a cost associated with the loss of information or of access to alternatives which may be genuinely preferred and occasionally superior to natural feeding. How to interpret the net benefit of these controls depends on the value placed on freedom of choice.

6.4.4 Developing comprehensive measures of costs and benefits

The more substantial these other health and non-health effects are, the more problematic the use of "cost per diarrhoea death/episode" as a guide to decision-makers becomes. It is, of course, possible simply to measure the different effects in different units and leave the decision-makers to make the necessary trade-offs using the disaggregated data. The danger is that the complexity of the process obscures the nature of implicit value judgements which may be adopted. To avoid this, one approach is to identify a single indicator which captures a broader range of benefits. Some researchers have employed measures such as infant mortality rates, life expectancy or nutritional status as proxies for general health status. The sensitivity of these indicators to specific interventions is generally poor, however, and it seems unlikely that any single statistic can adequately reflect all the important dimensions of health.

Another approach is to develop composite indices which combine mortality and morbidity effects. This can be done by assessing individuals on a number of aspects of their health, assigning numeric scores to each assessment, weighting them and adding the scores. Such indices are essentially arbitrary and have serious methodological problems (Torrance 1986). The "quality adjusted life year" is another kind of composite index, less arbitrary but potentially quite complex to derive. A promising recent formulation of a measure of health impact is the concept of healthy days of life proposed by the Ghana Health Assessment Project Team (1981). Using estimates of morbidity, case fatality and duration of disability together with data on life expectancy, the number of healthy days gained from health interventions can be calculated. The method does not account for qualitative differences between morbidity states and has substantial data requirements, but is conceptually simple. Care has to be taken with interpretation, however, since the apparent objectivity of this measure masks assumptions of comparability across age groups and an indifference to adult productivity (Barnum 1986).

The translation of the impact of interventions into money terms would be a useful way of facilitating comparisons between programmes, particularly if there are effects which lie outside the health domain.

Unfortunately, the more comprehensive measures (such as willingness-to-pay) are generally extremely difficult to ascertain. On the other hand, those financial measures which can be obtained more readily, such as savings in treatment costs, provide only a partial measure and one which is highly dependent on the nature of the existing distribution of services. Nevertheless, some have recommended that savings in treatment costs is a measure that should be further explored as a possibly useful proxy for benefit estimation (de Ferranti 1983).

One possible approach to the problem of valuing outcomes from these interventions in effect turns the question on its head (de Ferranti 1983). An example of this approach is as follows: in order to reduce diarrhoea by a given percentage, two different interventions are being considered. One costs more that the other, but has additional unvalued benefits. The difference in costs between the projects is a measure of how large the value of the additional benefits would need to be in order for the more expensive project to be worthwhile. Clearly, the more of these extra benefits that can be measured in monetary terms, the more manageable such an approach would be.

6.5 Equity

Even if it is possible to identify a suitable effectiveness measure that encapsulates all the consequences of various strategies, the results may not be sufficient to guide decision-making. For one thing the results say nothing about the distribution of the costs and benefits within society. The most cost-effective option may involve a programme in more accessible geographical areas and may disproportionately benefit the better-off. In a country with a policy of favouring the poor (and most countries pay at least lip-service to the notion of equity) there may be good reasons for choosing a less cost-effective but more equitable programme. There are several ways to handle this additional dimension - limit targets to the poorer groups, weight effectiveness or costs by some "poverty" factor, or consider equity as a secondary objective once a range of the most cost-effective options has been determined. With most of the interventions we have described, it is likely that equity objectives will, to some extent, be served at the same time as efficiency goals are met: the incidence of diarrhoea and the prevalence

of risk factors associated with diarrhoea (two important determinants of cost-effectiveness) are likely to be negatively correlated with income (though there are some exceptions such as the tendency to bottle-feed being higher in upper income groups in many developing countries). There are other factors which may work against the tendency for efficiency and equity goals to be realised by the same programmes: poorer people may be less likely to own radios, to have hospital births and to attend health education sessions and, consequently, may be more costly to reach.

6.6 Combinations of interventions

This document has focused on separate interventions, exploring their likely cost-effectiveness as independent activities. This is a helpful first step in articulating some of the important alternatives, their consequences and factors which influence their efficiency in preventing diarrhoea. In practice, of course, the range of potential options also includes various combinations of interventions. There has been little research devoted to investigating the impact of these but there are some clues which help to predict the likely consequences of implementing interventions together. There are three levels at which interactions between interventions may occur. Firstly, there may be cost savings associated with joint provision. It is difficult to see how this would arise with combinations of the additional vaccines (they are all delivered at different times and the estimates we have derived are already based on the assumption that some costs would be shared with those of the established vaccination programme), or with combinations of vaccines and education. But delivering more than one educational message at any one contact with the target may have important cost-saving implications, particularly with face-to-face education.

Secondly, the impact of an intervention on the risk factor through which it changes diarrhoea incidence may be influenced by the presence of other interventions. For example, education campaigns which incorporate related messages in a package (e.g. breast-feeding and weaning) may be more successful than the evidence from separate campaigns would suggest. On the other hand, attempting to change too many behaviours at once may simply overload educational targets who then fail to respond optimally

to any one of the messages. Vaccinations against one disease might enhance or reduce the protective effect of another, though there is no evidence of this for the three vaccines under discussion.

A third possibility, and one for which there is somewhat more evidence, is that the strength of the association between the risk factor and diarrhoea incidence may be altered by combining interventions. In particular, some proportion of the diarrhoea cases may be susceptible to more than one risk factor with the consequence that the impact of combined interventions is less than additive. There are two dimensions of the impact that interventions have on diarrhoea that shed light on the potential interaction between interventions: the aetiology of the diarrhoea prevented and the age of the health target. Cholera and rotavirus vaccinations prevent diarrhoea of specific and different aetiology. The aetiology of measles-associated diarrhoea remains largely unknown, but there are indications that it may be primarily dysenteric (Feachem and Koblinsky 1983). To the extent that this is true, the impact of a programme involving more than one of the vaccines we have discussed is likely to be additive.

The three non-vaccination interventions probably offer protection against a broad base of aetiological agents, though how discriminating they are has not been convincingly demonstrated. There is some evidence that breast-feeding protects against rotavirus (e.g. Chrystie 1978), cholera (Gunn 1979) and Shigella (Stoll et al. 1982), suggesting that combinations of breast-feeding with either rotavirus, cholera or measles vaccinations may be less than additive in their effects. However, the major impact on diarrhoea of any given increase in breast-feeding rates is on infants under 6 months, with no evidence of any effect beyond 12 months (Feachem and Koblinsky 1984). The scope for overlap is therefore limited if rotavirus vaccine is given at 6 months, measles at 9 months (only about 6% of measles-associated diarrhoeas occur between 9 and 11 months (Feachem and Koblinsky 1983)) and cholera in the second year.

The impact of weaning and hygiene interventions on diarrhoeas of specific aetiology has not yet been clearly demonstrated. Contrary to expectation, there is little evidence to show that hygiene education is particularly effective in reducing shigellosis, which has a relatively

low infective dose and is easily spread by direct person to person contact. Sircar (n.d.), after providing soap and water to a community, did find a reduction in shigellosis while overall diarrhoea incidence rate remained the same, but other studies have not confirmed that shigellosis is particularly sensitive to handwashing (Khan 1982; Black et al. 1981). Improving domestic hygiene, an intervention with potential impact over the whole under 5 age group and on diarrhoeas of different aetiologies, appears unlikely to be additive in its impact when combined with most other interventions. The exception may be interventions designed to improve weaning age nutrition, which are expected only to influence diarrhoea mortality, while hygiene improvements have only been demonstrated to reduce morbidity. Data on both the aetiology and age incidence of diarrhoea prevented through weaning education are scarce.

Given the increasingly widespread implementation of programmes promoting the use of oral rehydration solution, there is particular interest in ascertaining the effect of combinations of the interventions reviewed here with ORT. ORT is already a well established approach to diarrhoea control and the task for decision-makers is not likely to be one of choosing between ORT and other diarrhoea interventions, but rather of determining which interventions best complement ORT. With the exception of weaning education restricted to improving nutrition, all the interventions are potentially effective in preventing diarrhoea morbidity, an advantage ORT does not share to any significant degree. With respect to mortality prevention, ORT appears to be potentially equally effective at all ages and for all aetiologies causing acute watery diarrhoea. However, the possibility, in practice, of treatment failing with younger children and with diarrhoeas having rapid onset of dehydration, suggests that interventions designed to prevent such severe diarrhoeas may be effective in reducing an important mortality load which exists even with an operating ORT programme. ORT is largely ineffective in averting deaths from dysenteric or chronic diarrhoeas. Interventions such as measles vaccination, breast-feeding promotion and hygiene education, which appear to be effective against dysenteric or chronic diarrhoeas, are therefore particularly attractive. In some areas up to 50% of diarrhoea deaths are due to dysenteric or chronic diarrhoeas (Black, n.d.).

6.7 Recommendations

The inadequacy of much of the data, and the considerable variation that exists between the regions and countries of the world, makes it difficult to propose priorities for action with respect to implementation of diarrhoea prevention programmes. There are a few specific strategies which can be strongly recommended in all areas where they have not yet been implemented: changing hospital routines to encourage breast-feeding in mothers hospitalised for delivery; incorporating measles vaccine (and possibly in the future rotavirus vaccine) into on-going vaccination programmes and devoting resources to improve vaccination coverage, particularly in areas already served by the programme; and linking hygiene promotion activities to commercial efforts at selling soap. Education concerning breast-feeding, improved weaning practices and hygiene has considerable potential for reducing diarrhoea, but the exact form it should take is unclear and will probably vary greatly depending on particular country circumstances.

Recommendations for research are rather easier to make. The analysis in this document reveals substantial gaps in knowledge concerning the cost-effectiveness of alternative ways of controlling diarrhoeal diseases. These lacunae exist on both the cost and effectiveness side and for all interventions discussed. Our first recommendations are general ones concerning the approach to data collection:

- Data on costs are particularly scarce. More expenditure data based on actual experience, particularly in developing countries, are required for all interventions. Because the utility of these data is considerably enhanced if linked directly to effectiveness results, and because such data can be collected relatively easily once an evaluation mechanism is in place, researchers investigating the impact of interventions on diarrhoea or associated risk factors should be strongly encouraged to supplement their epidemiological research with cost studies.
- The resulting cost estimates should be published in papers presenting the findings. Published cost data should clearly indicate which costs are included in the analysis and the method used to estimate them, and should outline the nature of the inputs (number

and type of staff etc.) so that generalisations to other country settings may be possible. Assumptions used should be clearly stated and sensitivity analysis performed on important variables of uncertain value. The scale of the activity should be clearly noted to help clarify how size influences cost-effectiveness.

- To assist in the promotion of a consistent methodology, a basic checklist and guidelines for researchers should be developed and promulgated.

For individual interventions there are specific questions which require further exploration. Several, particularly those concerning the association between the risk factor and diarrhoea, are addressed in the published series on effectiveness. Here we single out a few which focus on the link between the intervention and the risk factor, which have both cost and effectiveness implications and on which research may be particularly profitable:

- Vaccinations. Cost data for whole vaccination programmes are relatively plentiful. Data are required, however, on the incremental costs of adding new vaccines to existing programmes, and on the cost-effectiveness of alternative strategies to increase coverage.
- Breast-feeding. Despite the relatively widespread implementation of programmes to promote breast-feeding, published cost data on these programmes are scarce. Retrospective estimates of costs, particularly for those programmes whose impact on breast-feeding has been measured, may be worthwhile. The extent to which increased breast-feeding rates resulting from promotion efforts reflect a change to partial, as opposed to exclusive, breast-feeding has not been studied. Given the significant differences in the implications for diarrhoea incidence and severity of these two feeding modes, this is an area which deserves further study.
- Weaning. The translation of nutritional impact into expected diarrhoea mortality changes is based on evidence from relatively few studies and embodies a number of assumptions which deserve further exploration, particularly the relationship between diarrhoea mortality rate and nutritional status, and the length of time for which weaning education has an effect on the average child.

- Hygiene promotion. This is a particularly under-studied intervention. In addition to investigating the impact and costs of hygiene education efforts, there is a need to look further at cultural and economic factors influencing hygiene behaviour and to study, in particular, the role of soap: the nature of the distribution and use of soap and other cleaning agents; the extent to which price acts as a deterrent to purchasing soap for hygiene purposes; the potential for domestic production and ways of capitalising on the heavy commercial promotion of soap in developing countries.

The cost-effectiveness of combinations of various interventions (including those involving ORT) is an area requiring further research.

- As a first step there is a need to determine the impact on diarrhoeas of different aetiologies of breast-feeding, weaning, hygiene and measles vaccination interventions.

Educational strategies are particularly important for most of the interventions reviewed here. On many of the factors influencing the cost-effectiveness of educational interventions, the literature remains silent. There is considerable scope for well designed evaluations to elucidate the nature of certain key input-output relationships.

- One topic which deserves particular attention concerns the dynamics of the educational process: What is the time profile of changes in behaviour and health in response to the intervention? How long-lasting are initial impacts on behaviour? How much continued investment is required to sustain these effects? Is there a critical size of target group or time exposure above which the impact becomes self-perpetuating?
- The transformation of new knowledge into changes in behaviour and hence improved health status is notoriously unpredictable, and it generally impossible to use intermediate outcomes to derive reliable estimates of health consequences: knowledge and behaviour merely serve as indicators of probably necessary, but certainly not sufficient, conditions for changes in health. In order to argue convincingly for more effort to be devoted to education, more health impact data from education campaigns are required.

For most of the research issues listed above, the answers are not expected to be straightforward - environmental, technical and epidemiological characteristics will have important effects on the results. Several field tests may be required to clarify the nature of this variation. Research itself is not costless, and careful thought is needed on ways of maximising its cost-effectiveness. Matching local management interests with those of international researchers and incorporating a costing component into on-going epidemiological evaluations are two strategies which are likely to improve efficiency. Much of this research is likely to be of interest to an audience wider than those concerned with diarrhoeal diseases, and a broad collaboration on these issues is clearly desirable.

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