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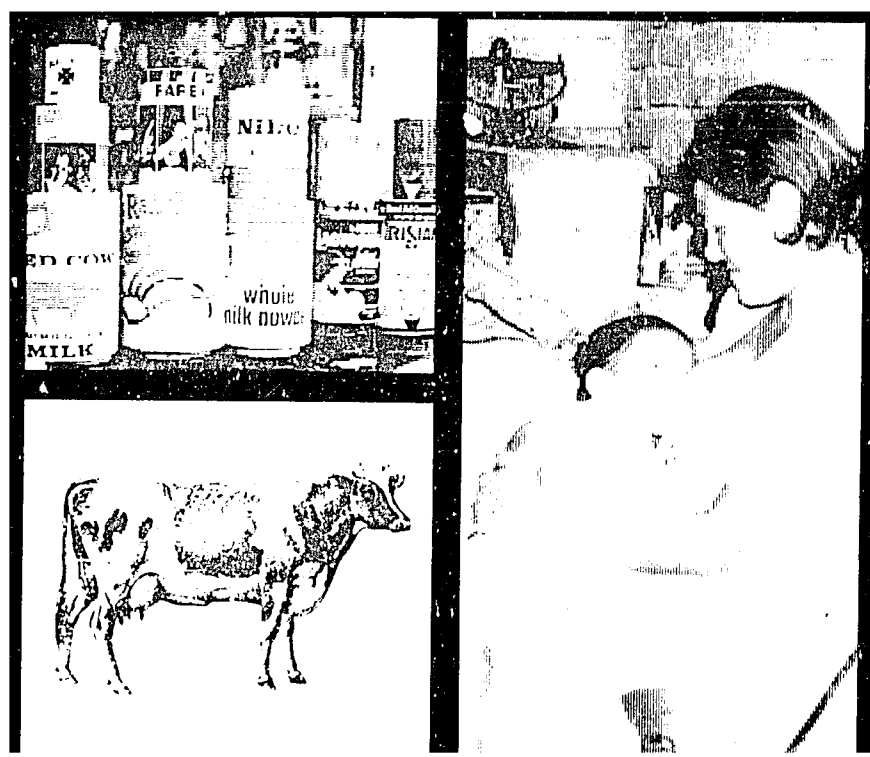
THE ECONOMIC VALUE OF BREASTFEEDING



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THE ECONOMIC VALUE OF BREASTFEEDING

The National, Public Sector, Hospital, and Household Levels

A Review of the Literature

Center to Prevent Childhood Malnutrition

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EXECUTIVE SUMMARY

The economic contribution that breastfeeding provides is especially crucial from a policy perspective in order to evaluate whether scarce public resources should be allocated to breastfeeding promotion and policies strengthened to support breastfeeding. In an analysis of this issue, it is important to consider the costs of both breastfeeding and bottle feeding, and alternately the savings associated with each.

At a **national level** the costs of breastfeeding include the potential loss of women's economic contributions, while the costs of bottle feeding include the aggregate expenditures on breastmilk substitutes and feeding bottles, and the infant and child lives lost due to illnesses associated with bottle feeding – about which little data are available.

While data on the loss of income due to breastfeeding is limited, estimates of national level expenditures for imports of breastmilk substitutes illustrate ranges of $1 million annually for small Central American countries to over $20 million per year in larger countries, with Brazil spending $70 million per year in the 1970's.

The value of breastmilk at a national level has also been estimated, based on the potential cost of replacing current breastmilk production with substitutes. Ranges in such costs are $12.5 million for Papua New Guinea to $140 million in Bangladesh.

The **public sector** faces costs related to the promotion of breastfeeding and tax revenues associated with production or distribution of breastmilk substitutes within the country. It also has expenditures for distribution of breastmilk substitutes, as through a Social Security System and government hospitals, and for indirect costs associated with illness associated with bottle feeding, such as costs for treatment of diarrheal and acute respiratory diseases. Debt repayment and interest payments on the debt because of use of scarce foreign exchange for the purchase of breastmilk substitutes need also to be considered.

Breastfeeding promotion campaigns that have a wide coverage include mass media efforts, have associated costs of $1 to $11 per mother. The potential costs of diarrheal treatment associated with a 25% decline in breastfeeding in Indonesia have been estimated at $40 million per year, or 20% of the national health budget. The number of deaths that would occur with a decline in breastfeeding are in the millions, and over one million infant lives would be saved with increases in the proportion of infants that are exclusively breastfed for the first 4-6 months of live. We do not assign a monetary value to such lives, but it is immense in social terms.

Public sector expenditures for family planning would increase substantially with decreases in breastfeeding, because of the substantial fertility-inhibiting effect that breastfeeding has. We estimate that expenditures throughout the world would need to increase by $65 million just to maintain current fertility.

Within **hospitals** the promotion of breastfeeding entails costs in staff promoting changes in hospital practices through workshops or advocacy on the part of hospital personnel and through costs of training of staff. Workshops to change hospital practices cost from $150 to $600 per participant, and staff training costs range from $10 to $860 per participant or $.5 to $5.50 per delivery. Cost savings per hospital have resulted from savings in staff time, reduced used of purchased formula, bottles, glucose water, and oxytocin. The largest maternity hospital in Lima currently spends over $60,000 for oxytocin, most which would not be needed if breastfeeding were to occur immediately after delivery rather than the current practice of delaying breastfeeding for 4-6 hours following delivery. The Jose Fabella hospital in the Philippines saved over $150,000 per year ($4.20 per delivery) in staff time with the institution of rooming-in.

Within **households**, the costs of replacing breastmilk with sufficient substitutes are exceedingly high for most developing country families, ranging from 6% of the minimum wage in Costa Rica (a cattle producing country) to over 100% of the minimum wage in Ghana, Nigeria and Ethiopia. While breastfeeding may inhibit a woman's ability to participate in the formal sector, in most countries formal sector employment is low for women. The non-formal sector is generally more conducive to breastfeeding. However costs of maternity leave and other benefits to support breastfeeding need to be taken into consideration. However there are limited data on such costs.

Households experience cost and time savings associated with reductions in illness and costs of treatment of illnesses in young children. They also experience savings in fertility and expenditures for family planning methods that breastfeeding provides.

Data on the above described costs and savings associated with breastfeeding are limited. Research needs to provide additional information for use by policy makers are outlined in this paper. They include the need for collection of information on each level.

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INTRODUCTION

Compelling evidence exists -- and continues to accrue -- establishing the benefits of breastfeeding for child and mother. Breastfeeding provides optimal nutrition for child growth and development, protects infants against disease and death, reduces post-partum health risks to the mother, and enhances child spacing. Solely from a nutrition and health perspective, the benefits of breastfeeding are well known.

Breastfeeding also provides economic benefits -- for a nation as a whole, and for the government; for health care institutions and, most importantly, for the household. These benefits are both direct, primarily in terms of the low cost of breastmilk relative to purchasing its substitutes; and indirect, principally in terms of the lower illness costs incurred by breastfed versus bottlefed children. It could also be argued that bottlefeeding may under some circumstances be economically advantageous, particularly if employment and tax revenues are generated by local production of breastmilk substitutes; or if bottlefeeding provides time savings for the mother and allows her to seek formal employment or engage in other forms of income generation.

The relative costs and savings associated with different modes of infant feeding depend on the country context -- the prevalence of exclusive or partial breastfeeding, the costs of infant formula, other substitutes and feeding supplies, the prevalence of infectious diseases such as diarrhea and acute respiratory infection, fertility and contraceptive patterns, and the market for women's labor. However, across regions we find common economic consequences of breast- or bottlefeeding. Documented experiences from one area can be drawn upon to inform policy decisions in another.

INTENT OF THE PAPER

In this paper, we focus on the economic value of breastmilk in developing countries. The review has three objectives. First, we present a framework for the analysis of the economic value of breastfeeding, highlighting the breadth of economic consequences of infant feeding practices. Second, we summarize existing research findings on the economic value of breastfeeding in developing countries in a policy-relevant manner. We then identify methodologic difficulties, gaps in the literature and possible avenues for fruitful future research.

To carry out the review, a search of literature published in scientific journals from the mid-1970s to the present was undertaken using bibliographic data bases (listed in Appendix A). Key articles were those which contributed original research findings, or presented a new interpretation of earlier empirical work from developing countries. To update relatively old figures, we also requested information from individuals knowledgeable about breastfeeding and its substitutes through a mailed questionnaire (see Appendix B). As a

result, we are able to incorporate very recent information, previously unpublished. We restricted our scope to experiences within developing countries, for the sake of comparability.

With a few notable exceptions, much of the research that is explicitly related to the economic value of breastfeeding has concentrated on two aspects: the importation of breastmilk substitutes (typically commercial infant formula) by the developing nations from the industrial world, and the economic determinants of infant feeding practices at the household level.

In this paper, we expand the scope to consider both direct and indirect economic aspects of infant feeding at the national, public sector, hospital and household, instead of emphasizing only direct, national-level costs. While we are interested in the household-level decisions about infant feeding practices to the extent that they deepen our understanding of economic aspects of breastfeeding, we do not review, as others have (Akin *et al*, 1984; Butz, 1981), the economic determinants of breastfeeding decisions. Regardless of whether a mother's decisions are derived from economic considerations, those decisions have economic consequences. It is those consequences on which we concentrate.

Because of the traditional emphases in research on the economics of breastfeeding, we were able to find a great deal of relevant information on the value of breastmilk substitutes imported into many countries, and the cost of these substitutes at the household level. We also were able to collect a sizeable body of quantitative information about the costs and savings to health care institutions of implementing breastfeeding promotion programs. However, information was scarce on public-sector expenditures (on either breastfeeding promotion or provision of breastmilk substitutes), and on the value of the mother's (or other caretaker's) time. We include in our recommendations areas in which further study and documentation appears to be necessary to complete the picture of the economics of breast- and bottlefeeding.

The review is organized into several sections. Following this brief introduction, we describe, in general terms, global differentials in breastfeeding; the relationship between infant feeding practices and infectious disease morbidity and mortality; and the factors thought to be responsible for transformations in breastfeeding patterns. Then we summarize the elements of the analytic framework for assessing the economic value of breastfeeding at the macro-level, from the perspectives of both the nation and the public sector; and at the micro-level, from the perspectives of the health care institution and the household. Next, we review current knowledge related to each of the elements of the framework, and discuss general limitations of the research methods and analyses. Finally, we highlight policy-relevant conclusions and identify gaps in the literature and suggest future research directions.

BREASTFEEDING PATTERNS

Within the large geographic regions of the developing world, the prevalence of both exclusive and partial breastfeeding is greatest in Africa and Asia, and lowest in Latin America. In general, the incidence and duration of breastfeeding are closely correlated with the level of development and urbanization within a region. Figure 1 depicts recent information from the Demographic and Health Surveys on breastfeeding between birth and 4 months, suggesting that the prevalence of exclusive breastfeeding among very young children rarely exceeds 40 percent, though partial breastfeeding typically exceeds 70 percent and often approaches 100 percent.

The situation is complex and difficult to summarize in a meaningful way: most infants in the developing world are receiving some breastmilk, and most are also partially fed with breastmilk substitutes (cow's milk, other traditional foods, or commercial infant formulas). However, we know very little about the relative contributions of breast- and bottlefeeding among the majority of infants that are partially breastfed, nor do we have adequate information on the types of breastmilk substitutes used.

Urban-rural and other regional differentials have been explained in several ways. Bottlefeeding is thought to be fostered by exposure to, and increased value placed on, "modern" behaviors, through both contact with Western health practices and exposure to mass media. Increased participation of women in the formal labor force (though low in many countries) has been thought to conflict with child care, particularly the relatively time-intensive breastfeeding activities. Behavior change also has been attributed to aggressive marketing of infant formula (Bader, 1976; Baer, 1981; Bernard *et al*, 1989; Ermann and Clements, 1984; Forman, 1987; Garfield, 1986; Griffin *et al*, 1984; Guthrie *et al*, 1985; Huffman, 1984; Latham, 1982; Mock *et al*, 1985; Winikoff and Castle, 1988a and 1988b).

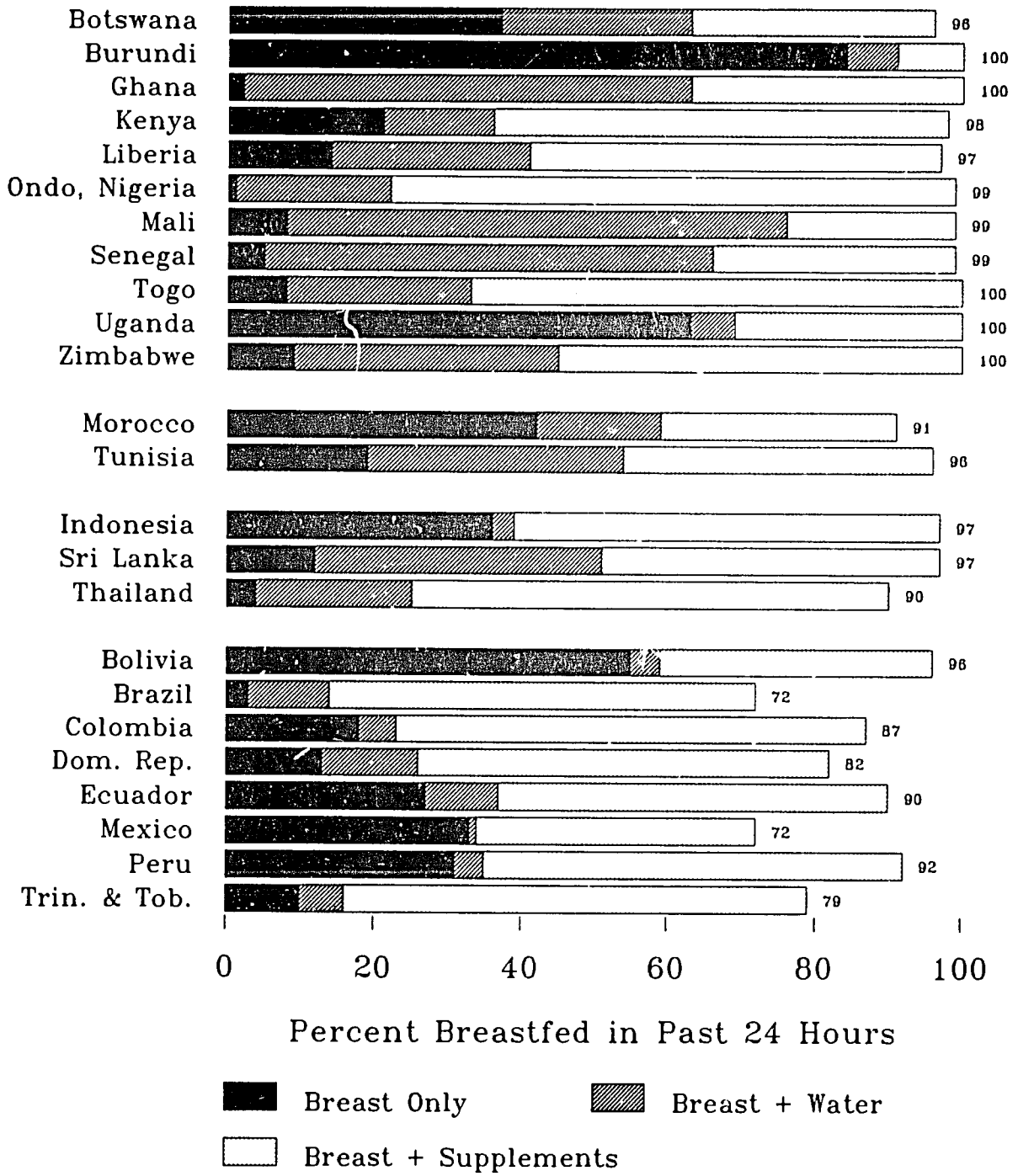
RELATIONSHIP TO HEALTH AND FERTILITY

Health Effects

A vast body of evidence has accrued to indicate that breastfeeding provides protection against infections in infancy, particularly those causing diarrheal disease. The overall effect of breastfeeding on infant illness and death, therefore, is greatest in settings with the highest endemic levels of diarrheal and other infectious diseases -- those with poor sanitation, inadequate health facilities, and other correlates of high infant mortality.

Exclusive breastfeeding is associated with considerably lower morbidity and mortality than either partial breastfeeding or exclusive bottlefeeding. The effect is greatest among the most vulnerable groups, infants in the first months after birth. Recent research in Brazil has shown that infants under two months who

Figure 1. Breastfeeding Patterns in Various Countries: Infants 0–4 Months



Source: Demographic and Health Surveys, 1986–1989

are not breastfed are 25 times more likely to die of diarrheal disease as are exclusively breastfed infants. For acute respiratory infection, the relative risk of death for infants between 0 and 2 months is nearly 4 when comparing breast- and bottlefeeding (Victora *et al*, 1987).

With respect to morbidity, the relationship between feeding mode and risk of becoming ill is also well established. Among 2-month-old infants in the Philippines, for example, those fully bottlefed were 18.5 times as likely to contract diarrheal disease as those exclusively breastfed. Infants fed with breastmilk and either non-nutritive or nutritive supplementary liquids were 3.5 and 14.4 times as likely to become ill with diarrhea, respectively (Popkin *et al*, 1990). Studies elsewhere show similar results, with the greatest protective effect of breastfeeding evident in the youngest ages.

The beneficial effect of breastmilk on infant health and survival has been confirmed, even when potential sources of bias and confounding variables -- mother's education, environmental conditions, and other determinants of infant health -- have been taken into account (Habicht *et al*, 1986). It is attributed to several factors. In developing settings, breastmilk substitutes often are prepared improperly -- diluted and/or prepared with contaminated water. As a result, they do not provide the needed nutrients and they expose infants to infectious disease. In addition, substitutes lack immunological factors present in breastmilk that, in themselves, provide protection against endemic diseases.

Given this information, any decline in exclusive breastfeeding would imply worsening infant health, in the absence of environmental and economic improvements. We have estimated elsewhere that an additional 7 million infants in the developing world would die of diarrheal disease and acute respiratory infection if no children were breastfed (and no other changes occurred in sanitation and other environmental conditions). Conversely, breastfeeding promotion would result in greater infant survival. If all women breastfed optimally -- exclusively through the first 4-6 months, and then partially through at least the end of the first year of life -- over one million infant lives would be saved (Levine *et al*, 1990).

Fertility Effects

Exclusive breastfeeding has been shown to greatly delay the return of fertility following delivery, correspondingly lengthening the interval between births in the absence of modern contraception. Breastfeeding is considered to be the single largest factor determining the length of post-partum sterility, serving as the primary means of contraception among the majority of the world's population, particularly in high-fertility settings where access to (and acceptance of) modern methods of contraception is extremely limited (Short, 1987).

Lactational amenorrhea (temporary infertility associated with breastfeeding is considered responsible for reducing total potential fertility per woman by nearly 7 births in Bangladesh, and around 5 births in Indonesia and Senegal (World Bank, 1984). In an analysis of data from several regions, a recent study estimates that breastfeeding is responsible for reducing total potential fertility by 34 percent in Africa, 30 percent in Asia and 16 percent in the Americas. At the same time, the use of modern family planning method contributes far less to reducing potential fertility (e.g. 5 percent in Africa). If the current median duration of breastfeeding declined by one-half, total fertility

would increase by approximately 30 percent in Ghana, Senegal, and Nepal, 17 percent in Haiti, and 37 percent in Indonesia (Thapa *et al*, 1988).

THE ECONOMIC VALUE OF BREASTFEEDING: ELEMENTS OF THE ANALYTIC FRAMEWORK

Awareness of the economic contribution of breastfeeding, and the costs associated with its decline, are crucial from a policy perspective, to evaluate whether scarce health, nutrition and family planning resources should be allocated toward breastfeeding promotion.

Selowsky (1978) states that three types of economic justifications drive an interest in improving children's nutrition through intervention activities:

> (a) The ones based on the notion that children's nutrition is a "public good" or an "externality" to the rest of society, i.e., the rest of society derives a consumption benefit from eliminating malnutrition . . . ; (b) the ones based on the "resource savings" effect of better children's nutrition. If particular social objectives to which governments are already committed (infant mortality rates, incidence of infectious disease, minimum standards of literacy in children, etc.) are the product of nutrition. . . better nutrition can, at the margin, be a cheaper intervention than these other interventions in achieving those objectives; and (c) the ones based on the notion that better infant nutrition can increase the future productivity of the individual, i.e., the "human" capital argument. (p. 15-16)

In the case of breastfeeding promotion interventions, there is still another justification: there is a substantial potential cost -- to governments, health care institutions and households -- of replacing the breastmilk currently being produced. It is essential, therefore, to examine a full range of economic aspects of infant feeding, direct and indirect.

To develop a systematic way of examining the economic value of breastfeeding, we begin from the simple premise that infants must be fed with breastmilk, with a breastmilk substitute, or with a combination of the two. Breastmilk substitutes may be those which are commercially available (i.e., infant formula, or powdered or canned milk) or traditional formulations prepared from fresh animal milk, cornstarch or local foods.

In many senses, breastfeeding competes with its substitutes to provide infant nutrition: one can displace the other, partially or completely. Both breastfeeding and alternatives to the use of breastmilk carry with them distinct costs. Therefore, the extent to which one substitutes for the other implies a level of savings, and a corresponding net cost (or savings). That is, if breastfeeding is entirely displaced by bottlefeeding, the net cost (or savings) will be the costs of bottlefeeding minus the savings resulting from not breastfeeding (i.e., the costs of breastfeeding).

While breastfeeding and bottlefeeding can be seen as competing in this sense, their

relationship to one another is significantly different than the relationship of tea to coffee, for instance, or homegrown vegetables to those purchased at a grocer's. For any individual mother (and infant), substitution usually can take place in only one direction: from the breast to the bottle. Given that breastmilk production will decline and cease if the infant stops suckling, the use of breastmilk substitutes can lead to an irreversible cessation of breastfeeding.

What are the types of costs associated with breastfeeding? Consider breastmilk as a good and breastfeeding as a service, each with associated direct monetary and time costs. Production of breastmilk requires additional calorie intake by the mother. The mother must devote a certain proportion of her time to breastfeeding, and this may imply conflict with employment or other economically vital activities. Breastfeeding may be enhanced by institutional support (such as specific facilities or personnel time), at least during the perinatal period. With respect to indirect costs, it is possible (though rarely found) that infants' health may be negatively affected if breastmilk is contaminated by pesticide residues, drugs or other substances, and resulting illness implies expenditures for health care, as well as potential reductions in the child's future economic participation. (See Table 1.)

Then, what are the types of costs associated with infant feeding with breastmilk substitutes, another combination of good and service? Infant formula or other substitutes are purchased (or produced) at some price, which can affect both the national economy through the balance of trade in the case of imports, and the expenditures by hospitals or households. In addition, equipment such as bottles and nipples must be purchased. Time is required of the mother or another caretaker for feeding, and this again may conflict with other activities.

Indirect costs of bottlefeeding spring from several sources. External debt (and interest payments) can increase proportionately with increases in importation of infant formula. Given the risks to infant health, particularly in settings of poor sanitation, expansion of bottlefeeding implies increases in infant morbidity and mortality, which, in turn, carry with them costs in health care and lost potential economic contributions for both the household and the nation. Given the shorter post-partum infertility associated with bottlefeeding (versus breastfeeding), an increase in bottlefeeding brings about additional needs for modern forms of contraception simply to maintain current fertility levels if this is a national policy. Again, this is felt as a cost both by family planning programs and by the women (or couples) themselves. Finally, bottlefeeding requires time, though not necessarily the mothers'.

The relative costs of breastfeeding and bottlefeeding are experienced at distinct levels. For a country and its government, the direct economic effects are those related to importation of breastmilk substitutes and local production of milk products, and to provision of breastmilk substitutes through Social Security or other public programs. More importantly, there are profound consequences of breast- and bottlefeeding for health and fertility, and these are experienced, in large part, within national health care systems and family planning programs.

There are two other perspectives of importance, as well: those of the health care institution providing obstetric care, and the household. At the level of the health care institution, the direct costs of purchasing infant

Table 1. Elements of costs and savings associated with breastfeeding in developing countries

	Costs of breastfeeding	Costs of bottlefeeding
National Level	■ Potential loss of women's productivity/economic contribution ■ Potential loss of taxes from sales of locally-produced breastmilk substitutes	■ Aggregate expenditures on breastmilk substitutes and supplies (goods costs) ■ Infant and child lives lost
Public Sector	■ Costs of breastfeeding promotion activities (mass campaigns) ■ Costs of breastfeeding promotion activities (within public health care institutions) ■ Potential loss of tax revenues from local breastmilk substitute manufacturers	■ Expenditures for breastmilk substitutes and supplies by government institutions (goods cost) ■ Public health care costs ■ Public family planning costs ■ Interest on debt incurred by importation of breastmilk substitutes
Hospital Level	■ Staff training ■ Education and support of new mothers ■ Modification of physical plant to allow rooming-in	■ Staff time for preparation and feeding ■ Expenditures on breastmilk substitutes, bottles and other equipment, pharmaceutical supplies (oxytocin, etc.) ■ Increased hospital stay and health care costs
Household Level	■ Maternal time for feeding and lost employment opportunities ■ Maternal dietary intake increased	■ Caretaker's time for preparation and feeding ■ Expenditures on breastmilk substitute, bottles and other equipment, fuel ■ Expenditures on health care for ill child ■ Caretaker's time for care of ill child ■ Loss of child's potential productivity/economic contribution ■ Expenditures associated with higher fertility, or increased use of contraceptives

formula and pharmaceuticals such as oxytocin[1], and the necessary equipment, as well as considerable staff time for cleaning bottles, preparing formula and feeding infants should be balanced against the costs of supporting breastfeeding among new mothers, modifications in hospitals to accommodate rooming in, training of staff, and other inputs. At the same time, critical indirect effects related to infant health are also felt at the level of the health care institution since breastfed children generally require fewer health care resources and have shorter lengths-of-stay.

At the level of the household, the direct material and time costs of bottlefeeding can be compared with the material (breastmilk substitutes, bottles, nipples, fuel, etc.) and time costs of breastfeeding. The indirect health and fertility consequences are most profoundly experienced at the household level, as it is the household members who must care for ill children and find a means of preventing (or supporting) the additional births resulting from reduced duration of exclusive breastfeeding. In the sections that follow, we examine the evidence on the costs of breast- and bottlefeeding from each of these perspectives.

FOUR PERSPECTIVES: THE NATION, PUBLIC SECTOR, HOSPITAL, AND HOUSEHOLD

The National Perspective

By considering the costs of alternative infant feeding practices at "the national perspective," we mean the aggregate costs for a nation, which will be a function of the size of the infant population, the prevalence of breastfeeding, and the available choices and costs of substitutes (imported or locally produced). Examination of national-level costs provides information on the magnitude of costs in a given setting, and the range among regions.

National-level costs data related to breastfeeding have usually taken several forms: estimates of the amount and value of current breastmilk substitutes, and estimates of the amount and value of breastmilk substitutes equivalent to current breastmilk production (or total required for all infants to be fed). That is, information is available on both actual costs of breastmilk substitutes and the imputed value of breastmilk, on a national level. However, in several cases the data provided indicate only the aggregate import (or production) of all milk products, without clarification about what proportion was used for infant feeding. There is also very little information on the economic factors related to local production of breastmilk substitutes, such as their contribution to overall employment and the national economy. The bases used for comparison in the research reported in this section differ from study to study: in some instances, the value of human milk is compared to the value of cow's milk; in others, to the value of imported infant formula. In many cases, complete information on the assumptions made is not provided in the literature, making full interpretation difficult.

Calculations of the value of breastmilk imports have shown a clear pattern of large

expenditures on imported breastmilk substitutes. The imputed value of breastmilk currently produced has also been substantial in the several cases studied. What has not been studied is the economic impact of locally-produced breastmilk substitutes on either the imports or the value of breastmilk.

Purchase of Breastmilk Substitutes

Since the early 1970s, the costs of infant formula and other breastmilk substitutes has been documented. Berg (1973) provided estimates of the cost of replacing the mothers' milk displaced when breastfeeding prevalence declined in several countries. In Singapore, for example, there was a decline in breastfeeding prevalence at 3 months from 71 percent to 42 percent among low-income households between 1951 and 1960. An additional estimated $1.8 million was required over that period to replace the human milk not produced. In 1958, approximately $17 million were spent on breastmilk substitutes in the Philippines; ten years later, after a 31 percent decline in breastfeeding prevalence, that figure rose to $33 million. In Colombia, milk imports increased by seven-fold between 1964-67 and 1968, as prevalence of breastfeeding during the first year declined rapidly. In Kenya, the decline in breastfeeding between 1950 and 1970 was reported to result in an $11.5 million loss – some two-thirds of the national health budget, or 20 percent of the average annual foreign economic aid (Berg, 1973).

In other settings, the pattern of large expenditures on imported breastmilk substitutes has also been observed. In the late 1970s, Thailand, the Philippines, Ethiopia and Colombia were each importing approximately $20 million in infant formula annually; Brazil spent $70 million, and Nigeria spent $50 million on imported formula (Borgoltz, 1982). Ecuador imports $1 million in infant formula annually (Artieda, 1990). In Honduras the amount of imported infant formula rose from approximately 236,000 kilos in 1970 to 859,000 kilos in 1988, while the amount of whole milk powder increased from 2.4 million kilos to 3.4 million kilos during the same period. In 1988 a total of more than $1 million was expended on import of infant formula and powdered whole milk (Honduran Ministry of Economics and Commerce, 1989).

In the early 1980s, substantial amounts were also being spent on imported milks by other Latin American settings: $10.8 million per year by El Salvador; $1.3 million by Guatemala; $2.3 million by Panama; and $3 million by the Dominican Republic (García *et al*, 1985). It is important to note that, while information on imports of milk products other than formula may provide some indication about the cost of breastmilk substitutes on a national basis, it aggregates milk used for all purposes, and is therefore not an accurate measure of only breastmilk substitutes.

The Value of Breastmilk Production

Estimates of the value of breastmilk (in terms of the infant formula **not** required) tend to rest on a couple of assumptions: that infants not breastfed would be fed with commercial (usually imported) infant formula; and that the cost of infant formula would remain the same if demand were greatly increased. This research tends to take as a starting point that breastmilk is a valuable resource which is undervalued because it is not included in national accounts. The value of breastmilk then is imputed to show this.

In a comprehensive discussion of the economic value of breastmilk in Indonesia, Rohde (1982) estimated the value of breastmilk consumed during the second year of life[2], based on quantity of breastmilk required by children of that age, prevalence of breastfeeding, and the cost of substitution with infant formula. He found that if the value of breastmilk were calculated into the Gross National Product, it would account for one-quarter of the total value of all production of goods and services in the country. Subtracting the cost of increases in maternal diets reduces the value of breastmilk produced to $62 million, in Rohde's estimate, which is equivalent to more than 80 percent of the annual Indonesian health budget in the early 1970s, when the work was carried out. Latham (1967) estimated that the production of human milk in Tanzania (40 million gallons) would be worth $22 million in imported powdered cow's milk.

The estimated annual cost of the 572 tons of breastmilk substitutes that would be required in Papua New Guinea if no infants were breastfed was $12.5 million in 1976. In 1977 it was estimated that the cost of bottlefeeding the 120 million infants in the world would be $15 billion (Marshall, 1988). Based on average milk production by cows, Jelliffe and Jelliffe (1975) stated that if all women in India replaced breastmilk with cow's milk, "an additional 114 million lactating cattle would be needed." In Bangladesh, if we estimate the cost of $1 per liter of infant formula, and the production of 375 liters of milk per child, $470 million annually would be needed to replace breastmilk produced for the first 2 years of life. In Argentina, it has been estimated that if all women breastfed for 6 months, 7,290,000 liters of milk would be produced (*Asociación de Ayuda Materna Nuñu*, 1990).

The Public Sector Perspective

Distinct from the national level, the public sector comprises the full range of government-supported agencies and programs, as well as the government itself. Relevant to the economics of breastfeeding, we would wish to consider direct costs to supplementary feeding programs, the Social Security system and government hospitals; indirect costs to infant and child health care programs, and family planning programs; supplementary feeding programs. Also of importance from the public sector perspective are tax revenues and the effect on the balance of trade and national debt.

Unfortunately, despite the importance of such information for policymaking, there are very little data on the economics of breastfeeding within the public sector; we are able to make only quite general qualitative statements, for the most part. The most complete information available of relevance to the public sector is that on the costs of breastfeeding promotion and accommodation, and of bottlefeeding, within (public sector) health care institutions. This is covered in a later section, "The Hospital Perspective."

With respect to direct costs to the public sector of breastfeeding, we could consider mass breastfeeding promotion activities. One estimate of the costs of such programs demonstrated that mass media for breastfeeding promotion would cost approximately $1 to $5 per mother exposed (Patel, 1989). Phillips, *et al* (1987) estimate costs at $1.50 to $11.00 per mother. We could also consider that breast-feeding carries with it the cost to the public sector of tax revenues not received from local manufacturers of breastmilk substitutes. Such tax revenues would be from the firms and from the wages of workers. Unfortunately, we could find no information on these sources of revenues.

The indirect costs of infant feeding mode – those associated with its health and fertility effects – are difficult to estimate. For instance, since exclusive breastfeeding prevents a large proportion diarrheal disease among infants, we can assume that an increase in breastfeeding would reduce the expenses related to diarrheal disease treatment (and a decrease in breastfeeding would increase treatment costs.)

In Indonesia it was estimated that if 25 percent of mothers stopped breastfeeding, an additional $40 million (20 percent of the nation's health budget) would have to be spent on diarrheal disease treatment (Rohde, 1982). These estimates were based on assumptions of the health detriment of bottlefeeding, and the cost per diarrheal disease episode. An underlying assumption is that improvements in environmental conditions would not take place, and that costs of treatment would remain constant over time.

In addition, while we can state that millions of infants currently are saved by breastfeeding, and a million or more would die annually of infectious diseases and malnutrition in the absence of breastfeeding, we cannot assign monetary value to those lives or their future productivity without imposing tenuous assumptions.

Beyond child health resources, we would expect breastfeeding and bottlefeeding to have different implications for family planning activities. Donors (including the United Nations, the private sector and the governments of industrialized countries) spend $64 million, $75 million and $184 million on family planning activities in Africa, the Americas and Asia, respectively (Brownlee, 1989). There are two ways to evaluate the consequences of breastfeeding on these costs. First, what additional funds would have to be allocated to family planning to maintain current fertility levels, if breastfeeding incidence and duration declined? Second, what additional fertility decline would be achieved if breastfeeding incidence and duration increased?

We could identify little research that addressed these questions directly. However, if we consider that breastfeeding currently accounts for reducing total potential fertility by at least 20 percent worldwide, it is reasonable to assume that family planning expenditures would have to increase by substantially more than 20 percent to compensate for the contraceptive effect of breastfeeding (Thapa *et al*, 1988), or an increase of $65 million. Rohde's (1982) study in Indonesia reported that an additional $80 million would have had to have been spent on family planning activities in the absence of breastfeeding. Again, these estimates were based on breastfeeding prevalence and assumed contraceptive effect of breastfeeding and cost of family planning efforts.

In countries where the public sector provides infant formula or milk to families with infants, public sector costs can be substantial. In the U.S., for example, over $500 million is spent annually on infant formula alone, through the Women, Infants, and Children Supplemental Feeding Program (WIC). This represents 40% of all infant formula sales, and more than one-third of the entire budget (Harvey, *et al*, 1989). In Bolivia and Mexico, milk for infants is provided through the social security system (Aliaga, 1990; Roman-Pérez, 1990).

One final consequence to the public sector of bottlefeeding is the effect on the balance of

payments and the associated interest on debt. No information could be found on these costs.

In sum, evaluation of the costs to the public sector of breastfeeding versus bottlefeeding is hampered by two factors: first, there is a paucity of data on public expenditures related to bottlefeeding; second, estimates of the most important contributions to public sector costs -- namely, those related to health and fertility -- are dependent on strong assumptions.

The Hospital Perspective

Given the widespread adoption of so-called "modern" practices in institutional maternity care, a set of modifications in hospital routines typically are required to accommodate breastfeeding. These include staff training (Naylor and Wester, 1985; Winikoff *et al*, 1987), rooming-in instead of separate neonatal and post-partum recovery wards (Mata *et al*, 1983; Hardy *et al*, 1982); and elimination of the use of infant formula and glucose water for newborns. These modifications imply initial and continuing costs, as well as direct and indirect savings.

Current research and case studies suggest that there are three primary sources of costs and direct savings: staff costs, training and education (including initial lobbying and policy change, training of hospital staff, and mothers' counseling and support); rooming-in (including changes in the physical plant, such as modification of rooms, change in the number of beds, etc.); and purchases of pharmaceutical and other supplies.

Since the settings from which the data presented below are not comparable in many ways, it is impossible to arrive at a convincing "bottom-line" estimate of the financial resources required to institute appropriate breastfeeding practices within hospitals in developing countries. The range of estimated costs and direct savings are summarized in Table 2. However, it is useful to outline the current knowledge of costs of various health care inputs that are affected by mode of infant feeding.

The information presented below supports the argument that costs associated with changes in hospital practices are more than offset by the direct savings realized. In interpreting these figures, it is useful to note that they refer to first-time efforts, for the most part: initial lobbying effort and/or conference is a one-time expense that can be combined with other professional meetings. Training of hospital staff -- the single largest cost -- remains effective for at least two years, and subsequent training activities would tend to be less expensive, given the original investment in developing materials, organizing the course, and other inputs.

With respect to direct savings, the substantial reduction in staff time with rooming-in is the source of the greatest savings, as documented in at least two cases. Reductions in expenditures on infant formula and other supplies, which are easier to measure, are consistent; hospitals can anticipate cutting their formula and bottle needs by 50-100 percent upon adoption of breastfeeding promotion practices.

There are also indirect sources of savings at the hospital level, principally related to the reduction in infant morbidity associated with breastfeeding. Hospital stays may be shorter for breastfed infants than for surviving bottlefed infants, because of lower morbidity (Daga and Daga, 1985).

Table 2. Summary of Costs and Direct Savings Associated with Changes in Hospital Practices to Promote Breastfeeding*

	ACTIVITY	SITE	COST	REFERENCE
COSTS	Lobbying/conference	hypothetical	$475/participant $0.01-1.00/delivery	Phillips *et al*, 1987
		Panama	$463/participant	Huffman, 1990
		Ecuador	$65/participant	Artieda, 1990
		Ethiopia/Liberia	$600/participant	Armstrong, 1990
		Colombia	$51/participant	Bruges, 1990
		Indonesia	$150/participant	Suradi, 1990 Masoara, 1990
	Staff training	hypothetical	$10-860/participant $0.05-1.40/delivery	Phillips *et al*, 1987
		Panama	$10-67/participant	Huffman, 1990
		Honduras	$212/participant $5.50/delivery	Huffman, 1990
		El Salvador	$44/participant	King, 1988
	Lactation counseling	hypothetical	$0.35-4.00/participant $0.35-4.00/delivery	Phillips *et al*, 1987
	Rooming-in	Panama	$0	Huffman, 1990
		Indonesia	$0	Daga, 1985
SAVINGS	Less staff time with rooming-in	Philippines	$4.20/delivery	Brownlee & Naylor, 1990
		Chile	$35/day	Labbok, 1990
	Less infant formula	Honduras	$0.50/delivery	Autotte, 1985
		Philippines	$0.82/delivery	Bagalay, 1989
	Fewer bottles	Honduras	$0.60/delivery	Autotte, 1985
		Philippines	$0.32/delivery	Bagalay, 1989
	Less oxytocin	Honduras	$0.10/delivery	Autotte, 1985

* Only listed are those cases in which absolute dollar amounts were available; see text for additional information on percent increase or reduction in costs in these and other settings.

Lobbying and Conferences

Phillips *et al* (1987) developed an estimate of the cost of resources for lobbying for change at the institutional level or through a conference. Using a set of the salary and other estimates, they arrived at a total cost of about $1,700 (in 1982), with no continuing costs once the new practices are adopted.

Alternatively, they considered promotion through a conference for 40 participants from 10 hospitals. Based on "a one-week conference/workshop involving four weeks' full-time preparation and follow-up by a medical officer [and] two weeks' secretarial assistance," they estimated a cost of about $19,000 (or $1,900 per hospital if shared equally, and $475 per participant).

Substantial economies of scale can be realized with respect to the number of births (and mothers) affected. The authors concluded that, over the first five years of the newly instituted policy, the cost per birth ranges from about $0.01 in a hospital delivering 20,000 babies a year to more than $1.00 in facilities delivering only 500 babies annually.

The figure estimated by Phillips *et al* compares well with experience in several settings. In Panama a national conference in 1983 set the stage for the country's breastfeeding promotion effort. The conference, attended by 75 health care professionals, cost $34,736, or $463 per participant (Samoyoa, 1988). Information on costs for lactation management courses in Ethiopia and Liberia indicate that nearly $600 (1988) per participant were required for 10 days of educational seminars, workshops and group discussions (Armstrong, 1990). A total of 53 and 38 individuals participated in the Ethiopia and Liberia courses, respectively. No data were provided on number of deliveries affected. Several national and regional breastfeeding promotion conferences held in Indonesia during the past 10 years cost an average of $150 per participant (Suradi, *et al*, 1990). In Ecuador a breastfeeding conference was held in 1990, with a total of 90 participants, with a cost per participant of $65 (Artieda, 1990). In Colombia a conference held in 1990 cost $51 per participant (Bruges, 1990).

Staff Training

For training of hospital staff, Phillips *et al* (1987) took as a starting assumption that education of hospital staff would require the time of one nurse for 12 weeks in preparation, implementation and assessment of a breast-feeding survey; a pediatrician's time for one week in preparation and presentation of a seminar; and the attendance of each nurse for half a day at the seminar. Based on this, and adding $250 for materials, they estimated a total cost of less than $1,300 for training 2-10 nurses in a small hospital to more than $4,000 to train 400 nurses in a large hospital. The cost per participant ranged from $858 to $10 (for two nurses in a 500-delivery hospital to 400 nurses in a 20,000-delivery hospital, respectively). Similarly, the cost per birth ranged from $1.35 in a 500-delivery hospital to $0.05-0.10 in a 20,000-delivery hospital over two years (the assumed duration of the effects of training is two years).

Though not strictly comparable to Phillips *et al*, data are available from regional training efforts in the Panama Breastfeeding Promotion Project. Since most of the health personnel trained through regional workshops were hospital workers, the use of regional cost data is relevant. The cost ranged from $9.83 to $67.41

per participant (Huffman, 1990).

Lactation Counseling in Hospitals

To estimate the cost of providing information to new mothers, Phillips *et al* (1987) hypothesized a model program involving the time of one nurse who is trained for two weeks who then discusses breastfeeding in half-day sessions with groups of 5-20 women. A one-year program would cost from $0.35 per delivery in large hospitals to $3.85 per birth in smaller facilities.

An alternative approach is one in which women who have successfully breastfed volunteer their time to organize and lead the courses for new mothers. In this case, the costs are substantially lower, as there are initial training costs but no salaries.

Rooming-in

Rooming-in, an important component in hospital-based breastfeeding promotion, may require no change in the physical plant, and often results in considerable savings in personnel costs. An evaluation of breastfeeding promotion in Panama found that only 25 percent of the sites studied reported that structural changes in the building were required to facilitate rooming-in. These changes included enlarging the postpartum area and/or removing cribs from the neonatal wards (Huffman, 1990).

No changes were required in the physical layout of one referral hospital in Indonesia, which has approximately 4,000 deliveries annually, to change to rooming-in (Suradi, *et al*, 1990).

Rooming-in implies considerable savings in staff time, since the time of nurses (or aides) needed for infant care and supervision in neonatal wards is substantial. One comparison in Chile showed that staff time could be reduced from 0.20 nursing units and 0.39 aide units per patient day with separate postpartum and nursery facilities, to 0.13 nursing units and 0.26 aide units per patient day with rooming-in. Using an estimated monthly salary of $300 for nurses and $125 for aides, rooming-in brought a 34 percent saving in personnel costs, or a reduction from $82 to $54 per day (Labbok, 1990). In Machakos, Kenya when rooming-in was initiated, no separate costs were provided for infants, thus decreasing costs (Mativo, 1990).

In the Dr. José Fabella Memorial Hospital in the Philippines, with an average of 100 deliveries a day and an average length of stay of 3 days per birth, impressive manpower savings have been documented. With the institution of rooming-in, nursing staff needs in the nursery were reduced by $154,286 per year, or approximately $4.20 per delivery. Personnel costs also were cut with reduced preparation of infant formula (i.e., elimination of formula room staff costs). An estimated $6,857, or $0.19 per delivery, were saved per year on this expense (Brownlee and Naylor, 1990). In an Indonesian hospital delivering 4,000 babies annually, the number of nurses in nurseries was reduced from 20 per shift to 12 per shift after rooming-in was instituted; 3 additional nurses were required in the post-partum ward. (This is a net decrease of 5 nurses per shift.) (Suradi, *et al*, 1990). At another Indonesian facility, the Bethesda Hospital, conversion to rooming-in resulted in a decrease in the number per shift of both nurses and aides from 7 to 4 and from 5 to 3, respectively (Gerung, 1990).

However, not all facilities experience a decrease in staffing needs. The Siriraj Hospital in Bangkok found that conversion to rooming-in, while costing no money, resulted in no

change in staffing requirements (Kolatat, *et al*, 1990).

Infant Formula and Other Supplies

Because breastmilk is an alternative almost without cost when compared to infant formula in a hospital, health care facilities that promote breastfeeding of newborns drastically reduce expenditures on formula, bottles, glucose and other pharmaceuticals.

The largest maternity hospital in Lima currently spends over $60,000 for oxytocin (Ciudad, 1990), most which is not needed if breastfeeding were to occur immediately after delivery rather than the current practice of delaying breastfeeding for 4-6 hours following delivery. The cost per ampule is $0.80 In Colombia, the cost is $0.20 per ampule (Bruges, 1990).

After instituting a rooming-in policy at Sanglah Hospital, Denpasar, Bali, costs of supplies dropped substantially over a six-month period studied. In this hospital, which delivers 3,000-3,500 babies a year, infant formula requirements fell to one-quarter of the original level (from 106 to 26 tins per month), and the need for IV fluid in the nursery was cut nearly in half (from 136 to 74 bottles per month)[3]. No expenditure data were given in the report (Soetjiningsih and Suraatmaja, 1986).

In the Philippines, instituting breastfeeding policies in the Dr. José Fabella Memorial Hospital resulted in an 80 percent decrease in the amount of milk purchased. Cost savings totalling $30,034 per year, or $0.82 per delivery, were realized from reduced purchases of infant formula. In addition, expenditures for bottles declined by $11,885 per year, or $0.32 per delivery (Bagalay, 1989; Brownlee and Naylor, 1990).

In several regions of Panama, breastfeeding promotion activities in hospitals decreased the number of bottles prepared for newborns by about one-half to two-thirds between 1984-86. In one hospital in Veraguas, the amount of infant formula used fell from 134 pounds in 1982 to 0 pounds in 1986; correspondingly, the number of bottles purchased was reduced from 3,299 to 0. In two hospitals in Cocle, the number of 2-oz bottles declined by 66%. In the Hospital Santo Tomás in Panama City, the number of bottles used in the newborn nursery fell from 113,503 in 1982 to 49,384 in 1985. At an estimated $0.20 per bottle, the reduction in costs totaled nearly $13,000 over the four years (Huffman, 1990).

Summary of Hospital Costs

As can be seen from this discussion, there are myriad sources of costs and savings associated with breast- and bottlefeeding within a hospital context -- and the magnitude of each is dependent on the size of the institution, personnel costs, changes required to accommodate breastfeeding and other factors. It is clear, however, that high rates of breastfeeding by new mothers is very likely to be a less costly means of infant feeding than is provision of infant formula. The major sources of direct savings are associated with lower materials cost (i.e., less purchase of infant formula and feeding supplies) and with lower staff requirements in nurseries.

The Household Perspective

Ultimately, it is within the household that breastfeeding decisions are made, and where many of the direct and indirect consequences

are experienced. At any point during her child's infancy, the mother weighs (implicitly or explicitly) the various costs of breastfeeding against those of bottlefeeding. The relevant costs of breastfeeding include, primarily, the cost of the woman's time and the constraints placed on that time by breastfeeding. The relevant costs of bottlefeeding, on the other hand, include principally the cost of breastmilk substitutes and supplies (including fuel), the time costs of bottlefeeding, and the costs of the health and fertility consequences.

Information on household-level costs is often difficult to interpret, in large part because many of the most important factors must be imputed: the value of the woman's time and the potential costs of illness and increased fertility. Ultimately, the picture that emerges is one in which bottlefeeding appears to be more costly than breastfeeding, directly and indirectly. However, given the shortage of convincing information on the actual opportunity cost of women's time (or the woman's perception of it), we cannot make definitive statements.

Cost of Materials and Supplies

Many estimates have been made of the projected cost to households of feeding infants adequately in the absence of breastfeeding. In general, these estimates extrapolate from an assumed **adequate** amount of breastmilk substitutes[4] and a known local cost of those substitutes.

The cost of replacement of breastmilk production has been reported in several ways: in absolute amounts, as a proportion of workers' income, or in terms of the material resources (including livestock) that would have to be utilized. The "bottom line" typically has been consistent: replacing breastmilk is far more expensive than the cost of the additional food consumed by a breastfeeding woman -- and the money required to **adequately** feed an infant would comprise at least one-third of an average wage laborer's income. (See Table 3 for a summary.)

Cow's milk is the most commonly used breastmilk substitute. Berg (1973) states that a Ugandan laborer would have to devote one-third of his income to feed an infant with cow's milk. A Chilean worker would spend 20 percent of his income on that type of breastmilk substitute (Berg, 1973). Feeding a six-month-old child with cow's milk in Tanzania would take nearly half the average minimum wage (Latham, 1967).

Infant formula typically is substantially more costly. In Kenya in 1976, adequate amounts of commercially available infant formula would require half the daily income (about $0.80) of an adult roadworker or similar laborer (Latham, 1977). In 1989, infant formula would cost $189 for the first year, or 47 percent of the minimum wage (IBFAN, 1989).

Evidence from Calcutta suggests that half of an employed mother's earnings would have to be spent on infant formula to replace the breastfeeding not carried out while working. This assumes that, while home, she would continue to breastfeed (Reutlinger and Selowsky, 1976). If the woman shifted to exclusive bottlefeeding, she would have to devote 75 percent of her wages to feeding her infant if she used cow's milk, and 100 percent if she used a commercial infant formula (Latham, 1977).

Based on surveys in Ethiopia, Nigeria, India and the Philippines, the World Health Organization estimated that feeding an infant

Table 3. Household-level Expenditures on Breastmilk Substitutes: The Cost of Adequate Quantities of Breastmilk Substitutes

COUNTRY	AGE OF CHILD	SUBSTITUTE	COST	REFERENCE
Botswana	infant	formula	18% minimum wage	IBFAN, 1989
Brazil	1-6 month old	formula	35% minimum wage	U. de São Paolo, 1990
Burma	3-month old	formula	11% minimum wage	Cameron & Hofvander, 1975
Burma	6-month old	formula	16% minimum wage	Cameron & Hofvander, 1975
Chile	infant	cow's milk	20% worker's wage	Berg, 1973
Costa Rica	1-month old	formula	6% minimum wage	CEFEMINA, 1990
Costa Rica	2-month old	formula	12% minimum wage	CEFEMINA, 1990
Costa Rica	3-month old	formula	23% minimum wage	CEFEMINA, 1990
Costa Rica	4-month old	formula	34% minimum wage	CEFEMINA, 1990
Egypt	3-month old	formula	50% minimum wage	Cameron & Hofvander, 1975
Egypt	6-month old	formula	63% minimum wage	Cameron & Hofvander, 1975
Ethiopia	infant	formula	70-100% per capita GNP	WHO, 1979
Ghana	infant	formula	198% minimum wage	IFBAN, 1989
India	infant	formula	50-80% per capita GNP	WHO, 1979
Kenya	infant	cow's milk	50% worker's wage	Latham, 1967
Nigeria	infant	formula	30-65% per capita GNP	WHO, 1979
Nigeria	infant	formula	264% minimum wage	IBFAN, 1989
Philippines	infant	formula	15-40% per capita GNP	WHO, 1979
Tanzania	infant	cow's milk	50% worker's wage	Latham, 1967
Uganda	infant	cow's milk	33% worker's wage	Berg, 1973
U.S.A.	infant	formula	2.5% per capita GNP	Lamm, *et al*, 1977
Yemen	6-month old	unspecified	8% minimum wage	WHO/UNICEF, 1990
Zimbabwe	infant	formula	25% minimum wage	IBFAN, 1989

adequately with commercial formula would cost from 15 to 140 percent of the annual per capita income (WHO, 1979). In Ethiopia, 70-100 percent of per capita GNP would have to be spent on infant formula; in India, 50-80 percent; in Nigeria, 30-65 percent; in the Philippines, 15-40 percent.

UNICEF data indicate that the monthly costs of feeding a 6-month-old infant with breastmilk substitutes range from $3 in the People's Republic of Yemen to $45 in Ethiopia, and between 8 and 120 percent of the minimum wage. This wide range can be attributed to differences among countries in both the cost of breastmilk substitutes and the size (and adequacy) of the minimum wage. The average monthly cost of infant feeding was calculated to be $22 (McCann *et al*, 1981; Berg and Brems, 1989). In Pakistan, the monthly cost of feeding a 3-month-old infant with formula was estimated at $18 (Lambert, 1988, quoted in Berg and Brems, 1989).

Cameron and Hofvander (1975) estimated the cost per day of complete artificial feeding at 3 months and at 6 months in 10 developing countries in the Near East, Asia and the Americas. They found that at 3 months feeding would cost from 11 percent of the minimum wage in Burma to nearly 50 percent of the minimum wage in Egypt. At 6 months, increased nutrient requirements implied still greater expenditures: from 16 percent of the minimum wage in Burma to 63 percent of the minimum wage in Egypt. Examining the potential effect of artificial feeding on the salaries of workers in various occupations, they found that feeding young infants (0-2 months) would require between 18 and 66 percent of the salary of a hospital orderly (depending on country), 7 to 57 percent of the salary of a ministry clerk, and 8 to 14 percent of the salary of a junior staff nurse. Feeding older children would require 25 to 93 percent of the salary of a hospital orderly, 10 to 80 percent of the wages of a clerk, and 9 to 19 percent of a nurse's salary.

In a recent study of the cost of **adequately** feeding infants (for one year) with commercial formula, IBFAN found that households would have to spend $216 in Botswana (18 percent of the minimum wage); $224 in Zimbabwe (25 percent of the minimum wage); $203 in Sierra Leone (108 percent of the minimum wage); $311 in Ghana (198 percent of the minimum wage); and $558 in Nigeria (264 percent of the minimum wage) (IBFAN, 1989).

In Costa Rica, the cost of infant formula would be $8.35, $16.70, $33.40 and $50.14 for months 1, 2, 3 and 4. This represents 6%, 11%, 23% and 34% percent of the minimum salary of $145.71 per month (CEFEMINA, 1990). For the first six months of life, in urban Brazil it would cost an average of $16.90 per month to feed an infant using commercial formula -- 35 percent of the monthly minimum wage, and 49 percent of the per capita GNP (Universidad de São Paolo, 1990).

Several studies have compared the cost of breastmilk substitutes with the cost of the additional nutrients required by lactating women. It has been estimated that energy in human milk is produced with an efficiency of approximately 80 percent for calories, and 40-60 percent for protein (NAS, 1989). This implies that it is likely to be the most efficient (and the lowest cost) means of producing infant nutrition, since the inputs into breastmilk can come from non-animal sources (beans, rice, etc.).

From a detailed study in the Ivory Coast,

Greiner *et al* (1979) found that the additional food for a lactating mother would cost a total of between $51 and $102 for breastfeeding throughout two years, depending on whether the additional calories come from foufou[5] and peanut sauce or from the less expensive rice and peanut sauce. (Daily costs range from $0.07 to $0.14.) They compared this with the total goods cost of artificial feeding, including breastmilk substitute, equipment and fuel. Bottlefeeding for two years would cost between $305 and $386 ($0.42-$0.53 per day), depending on whether imported infant formula was used during the entire period or whether whole dry milk was used instead of formula after month 4. In sum, the goods cost of artificial feeding was found to exceed that of breastfeeding by an order of magnitude of at least three.

As stated earlier, calculations of the cost of replacement of breastmilk with cow's milk or infant formula assume that an **adequate** amount of food will be provided. However, there are strong suggestions that, given highly constrained household resources, inadequate amounts and highly diluted formula are used to reduce the high cost of feeding infants with substitutes. Reutlinger and Selowsky (1976) estimate that the marginal propensity to spend for infant foods from additional family income is about 5 percent. That is, every additional dollar of income (from women's employment, or other sources) will result in the expenditure of only 5 cents on infant formula -- apparently not enough to cover replacement of breastmilk, if the woman shifts from exclusive to partial or full bottlefeeding. This implies that displacement of breastmilk will have substantial negative effects on infant health.

Again, as for the national-level costs, none of the figures above include the costs of bottles, other feeding equipment, or the fuel required to heat formula and sterilize equipment.

Time Costs

Considerable attention has been given to the time costs of breastfeeding, and the possible conflict between women's employment and breastfeeding. In developing a theoretical perspective on breastfeeding trends during the process of economic development, Butz (1981) argues that the duration of breastfeeding will be reduced by an increase in the employment of women in activities that are less than fully compatible with child care (and breastfeeding), or an increase in the value of a woman's time (at the margin) in home agricultural or cottage industry, if this implies a shift from work that is compatible with child care to less compatible work.

The basic notion is that breastfeeding will conflict with mother's employment -- both because of the actual hours required for feeding, and because of the constraints imposed by the difficulty of being away from the child for extended periods. Breastfeeding, therefore, can be considered to imply an "opportunity cost" when women would otherwise enter the labor market and earn a wage. Ideally, we would be able to impute the value of the time spent in breastfeeding based on the wages the woman is not earning (but could earn). However, such imputation is highly setting-specific, based on the productive characteristics of the woman, the labor market demand, the time spent breastfeeding and the degree of conflict between employment and child care.

The actual amount of time required for infant feeding has been studied in several instances, though the number of mother-infant pairs has, in all cases, been extremely small. In

addition, many of the direct time costs of preparation of breastmilk substitutes have been excluded in several of the studies. Time spent breastfeeding varies with the age of the child but can take up to 2-3 hours per day (Huffman, *et al*, 1980). However, women often breastfeed concurrently with other household or income producing activities (such as cooking, other child care, selling produce, and even farming).

The expected inverse relationship between extent of breastfeeding and women's participation in the labor force has not been found consistently. Van Esterik and Greiner (1981) reviewed more than 80 studies from a wide range of developed and developing settings, and found that employment was cited as a major reason (more than 20 percent) for not breastfeeding in only 4 of those studies. In several studies women's employment has been found to be associated with greater levels of breastfeeding, and in many others employment has appeared to have no effect on breastfeeding behavior. Self-reported reasons for infant feeding practices may not be the best indicator of actual determinants, as noted by Butz (1981). Mothers may be unaware of, or unwilling to acknowledge, economic motivations, even when they strongly influence behavior.

There are instances in which employment does appear to conflict with breastfeeding. In low-income households in Central Java, both employment and the wage rate were primary determinants of the duration of breastfeeding, and therefore of infant nutritional status, even when controlling for confounding factors such as education. In fact, the apparent negative relationship between mothers' employment and infants' nutritional status was largely explained by differences in breastfeeding duration between working and non-working mothers (Soekirman, 1983).

In the Population Council's major study of infant feeding in Bogota, Bangkok, Nairobi and Samarang, mothers' employment outside the home was found to be related to early supplementation in only two sites (Bogota and Bangkok). The determinants of whether working had a negative effect on breastfeeding were found to be working conditions, scheduling and child care arrangements -- all of which are potentially modifiable through employer regulation and other policy options (Winikoff and Castle, 1988b).

In interpreting the results of studies of working women and breastfeeding, it is often very difficult to disaggregate cause and effect. Education tends to influence both breastfeeding and likelihood of employment, and must be taken into account when analyzing the behavior of working and non-working mothers. In addition, the type of work is likely to influence breastfeeding more strongly than whether or not the woman is employed.

Whether women consider breastfeeding or bottlefeeding as the more convenient option is strongly affected by their culture and working situation. In Mali, for instance, it is expected that infants will accompany their mothers at all times, and breastfeeding is fully acceptable on the job and elsewhere (Dettwyler, 1987).

A set of employer policies, implemented either on the national level or at the individual firm, reduce the extent to which breastfeeding conflicts with income-generating activities. As Bamisaiye and Oyediran (1983) stated: "One must conclude that the better solution is to require the employer to assist the mother to breastfeed, by adapting the work-environment, rather than to require the mother to adapt her breastfeeding behavior" (p. 1870).

These policies include: sufficient maternity leave to establish exclusive breastfeeding; nursing breaks during the working day; on-site day care (creches); flexible working hours; job-sharing; and part-time work with adequate wages and worker protection (Jelliffe, 1977). Each of these, however, implies a set of costs. Unfortunately, no information was available to estimate the costs of employer accommodation of breastfeeding.

The somewhat elusive opportunity costs of breastfeeding, as yet to be calculated, must be balanced against the time costs of bottlefeeding. Taking into account the time required for preparation of breastmilk substitutes, bottlefeeding has been found to be at least three times as time-intensive as breastfeeding (Leslie, 1988). This includes only the time of preparation and feeding of formula, and excludes other time costs associated with bottlefeeding: gathering fuel, purchasing formula or other substitutes, and caring for ill children (in settings where artificial feeding leads to greater morbidity). This last time cost, hidden in most estimates of time factors associated with bottlefeeding, is far from trivial. For example, that time would include the time demands associated with seeking health care and with appropriate oral rehydration therapy of diarrheal disease (Marlett, 1988).

Despite these higher time costs, bottlefeeding does provide women with flexibility and short-term convenience. If low-cost child care is available, women's job opportunities and wages are relatively high, and employment is incompatible with breastfeeding, shifting infant feeding responsibilities from the mother to another caretaker may be economically advantageous.

Indirect Household-level Costs

The most important economic aspects of breastfeeding experienced at the household level are those which are most difficult to quantify. Breastmilk's protective effect from infectious diseases implies lower household costs on health services, pharmaceutical supplies, and time spent in caring for ill children. Similarly, the contraceptive effect of breastfeeding implies lower fertility for the individual couple -- and therefore either lower expenditures on contraceptive services and supplies or a smaller completed family size. Unfortunately, no information on the economic value of these consequences could be found.

CONCLUSION

In this review, we have discussed the economic value of breastfeeding from four perspectives: a nation as a whole, the public sector, the individual health care institution, and the household. To do this, we have attempted to bring together information on the importation of breastmilk substitutes; the costs and savings associated with breastmilk promotion in health care institutions; and the material and time costs at the household level. More importantly, we have tried to identify the hidden costs that have not yet been quantified in existing research, principally those associated with the health and contraceptive effects of

breastfeeding.

It is difficult to summarize the overall economic value of breastfeeding in the developing world, given the lack of information and the differences by setting. However, some general conclusions can be drawn and supported:

NATIONAL LEVEL

- Large increases in national expenditures on breastmilk substitutes occur when the prevalence of breastfeeding declines; specifically, 375 liters of milk are required to replace mother's milk during the first two years of a child's life.

PUBLIC SECTOR

- Health and fertility effects, while difficult to measure, are likely to be the largest public sector expense related to bottlefeeding.

- In settings with a negative balance of trade, the contribution of breastmilk substitute imports is likely to have a detrimental effect.

- Tax revenues derived from local manufacturers of breastmilk substitutes may constitute positive consequences of bottlefeeding.

INSTITUTIONAL LEVEL

- Promotion of breastfeeding within health care institutions is cost-effective, in that savings in material and staff resources are very likely to greatly exceed potential costs. The extent to which institutional policies affect overall breastfeeding practices is dependent on the coverage of the population by formal maternal health services.

- The health effects of breastfeeding, often overlooked in calculations of the cost of bottlefeeding, are relevant to the health care institution.

HOUSEHOLD LEVEL

- In most settings in the developing world, provision of adequate breastmilk substitutes would require at least 50 percent of the minimum wage; in many cases, the cost of breastmilk substitutes would be greater than the household income.

- Households in which infants are partially (or exclusively) bottlefed are likely to economize on infant feeding by diluting formula or providing smaller quantities.

- In developing countries where sanitation is poor, the costs in illness related to inappropriate infant feeding are likely to far exceed the costs of supplemental food to the mother and the mother's time.

- The opportunity cost of breastfeeding among women who could enter the formal labor force could be reduced by employer policies that allow worksite child care.

In general, this review has concentrated on economic consequences of feeding decisions and not on the decisions themselves. Infant feeding decisions, while explicitly made and implemented at the household level, are strongly influenced by national and institutional policies. Therefore, changes in those policies can be expected to effect changes in patterns of household decisionmaking. For instance, health care providers' endorsement of bottlefeeding has been cited as a primary cause for new mothers failing to initiate (or carry on with) breastfeeding (Winikoff and Castle, 1988a). Conversely, in-hospital promotion of

breastfeeding is seen as a vital means of increasing the incidence and duration of appropriate breastfeeding (WHO/UNICEF, 1990). At the national level, regulation of the import and distribution of infant formula is a critical component in breastfeeding promotion. Investigation of the policy options related to breastfeeding promotion is one of the logical next steps.

Gaps in the Literature and Research Directions

As indicated earlier, to develop a complete picture of the economic value of breastfeeding, additional information is required. Useful avenues for future research are highlighted below:

- Estimate the economic contribution of breastfeeding to child survival and population programs in specific settings, based on the prevalence of various breastfeeding practices, the contraceptive and health effects of those practices; and the size of the population.

- Study actual expenditures on infant formula by households, by income group. Together with this would be an evaluation of the extent of adequate infant feeding, versus the extent of dilution of formula and other short-term attempts at saving money at the household level. This research would help identify the infants most at risk for suffering negative health consequences of bottlefeeding.

- Investigate the relative costs of different types of combinations of infant foods, emphasizing the possible economies associated with appropriate use of traditional foods.

- Review national policies related to the import of infant formula, to determine the feasibility and impact of promoting breastfeeding through regulation of infant formula importation.

- Review specific employer policies related to the accommodation of the breastfeeding mother in the workplace, with emphasis on the initial and continuing costs of such activities, and the efforts required to overcome barriers to institution of such policies.

- Estimate the costs of large-scale breastfeeding promotion programs, and measurement of their impact on household decisions regarding infant feeding.

- Improve data on breastfeeding and other infant feeding practices, including expenditure data in demographic and health surveys.

- Study household beliefs about the health and contraceptive effects of breastfeeding, to understand how the relative costs and benefits of breast- and bottlefeeding are perceived.

- Develop improved theoretical framework to conceptualize household decisionmaking about infant feeding, and understand the relationship between perceptions of economic consequences and realized economic consequences.

NOTES

1. Oxytocin, a naturally occurring hormone necessary to restore the uterus to its natural size after delivery, is induced by immediate suckling and lactation. Mothers who do not breastfeed are frequently given pharmaceutical oxytocin.

2. Which is only about 33 percent of the amount of breastmilk produced during the first year.

3. Strictly speaking, this cannot be considered direct savings, as it resulted from a reduction in diarrhea and infection among breastfed infants.

4. The amount required to replace approximately 375 litres of breastmilk for the first two years of life (Caliendo, 1979).

5. Foufou is a starchy staple made of yam, plantain or other starchy vegetable.

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Appendix A. Computer Databases Used for Literature Search

AGRICOLA

CAB ABSTRACTS

DISSERTATION ABSTRACTS

ERIC

FAMILY RESOURCES

INDEX OF INTERNATIONAL STATISTICS

MAGAZINE INDEX

MANAGEMENT CONTENTS

MEDLINE

POPLINE

SOCIOLOGICAL ABSTRACTS

center to prevent childhood malnutrition

Suite 204
7200 Wisconsin Avenue
Bethesda, Maryland 20814
USA

Phone: 301 986 5777
Telex: 258 3062

Center to Prevent Childhood Malnutrition
Questionnaire on Breastfeeding Promotion
Costs and Savings

The Center to Prevent Childhood Malnutrition currently is compiling information on the economic value of breastfeeding -- the costs and savings of promoting appropriate breastfeeding practices. Information is needed on the amounts and costs of infant formula, bottles and other materials; and the cost of promotion activities (training, educational materials, changing to rooming-in practices, etc.).

Any information that you can provide would be extremely helpful. We realize that you may only be able to answer some of the enclosed questions. Even if you need to leave many questions unanswered, your information will be very helpful. As you fill out the questionnaire, please cite sources and provide information for as many years as possible.

There are two major sections: one is on national expenditures for infant formula, and the other is on hospital practices. If you do not work in a hospital/clinic setting then only fill in the first section.

All respondents will receive a free copy of the final report.

THANK YOU VERY MUCH FOR YOUR HELP.

Sincerely,

Sandra L. Huffman, Sc.D.
President

Affiliated with The Johns Hopkins University, Department of International Health.

CENTER TO PREVENT CHILDHOOD MALNUTRITION
QUESTIONNAIRE ON BREASTFEEDING PROMOTION COSTS AND SAVINGS

Name _____ Organization _____

Address _____

_____

_____

Date _____ Country _____ Currency _____ = $1.00

NATIONAL LEVEL COSTS

1. How many kilos or pounds of infant formula are imported annually?

Year	Amount Imported (Circle unit=kg/lb/ton)	Cost
19		
19		
19		
19		
19		
19		
19		
19		
19		

Source of information:

From what countries is infant formula imported?

_____

Source of information _____

What is the unit cost of imported infant formula?

Wholesale cost (Unit=kg/lb) ____ per ____

Retail cost (Unit=kg/lb) _____ per _____

Source of information _____

2. Is infant formula manufactured domestically in your country?
Yes____ No ____.
If yes, what companies manufacture it?

Name of Company	Brands
_____	_____
_____	_____
_____	_____

What is the unit cost of domestic infant formula?
Wholesale Cost (Unit=kg/lb) _____ per ____
Retail cost (Unit=kg/lb) _____ per ____

Source of information _____

3. What proportion of infant formula is purchased by :
Public Institutions _____%
Private Institution _____%
Households _____%
[This information may be available through manufacturers literature.]

4. Does the government distribute infant formula or milk through its programs?

Yes _____ No _____

If yes, how?

	Amount (unit=kg/lb)	Cost per year to Govt.	Year
Social Security System	_____	_____	_____
Maternal and child clinics	_____	_____	_____
Other (explain) _____	_____	_____	_____

5. Has there been a national or regional conference on breastfeeding promotion in your country?

a. When was the conference held? _____

b. How many participated? _____

c. In general, who were they? (e.g. physicians, nurses, health educators, etc?
_____

d. What was the cost (total cost or per participant)?
Total cost? _____
Cost per participant? _____

Source of information_____

HOSPITAL PRACTICES

1. How many deliveries occur in your hospital (or clinic) each year?

Year	Number of Deliveries
19	
19	
19	
19	
19	
19	

Source of information: _____

2. What is the approximate salary of each of these health care workers:

Worker	Salary (monthly or yearly?)
Pediatrician	
Obstetrician	
Nurse in maternity ward	
Nursing aid	

3. Does your institution train **staff** to promote breastfeeding among new mothers? Yes _____ No _____

If yes,

How many staff were trained each year?

Year	Number Trained
19	
19	
19	
19	
19	
19	

4. Does your institution counsel **mothers** (during prenatal visits, antenatal care, or postpartum visits) to promote breastfeeding? Yes____ No_____

If yes, how many **mothers** receive counseling each year?

Year	Number Trained
19	
19	
19	
19	
19	
19	

Who does the counseling (type of staff)?

_____

How is the counseling done: Individual discussions, group meetings?

_____

Source of information _____

5. Please describe the hospital routine following delivery.

When is the mother first able to breastfeed?

On delivery table _____
Within 1/2 hour after birth _____
Other (describe) _____

Is there rooming-in? Describe current terms for rooming-in.

For vaginal deliveries_____

_____

For caesarian deliveries_____

_____

Is glucose water given to newborns? Yes _____ No_____

If yes, When?

Routinely _____
When requested by M.D. _____
Other (describe) _____

_____

How much glucose was purchased for newborns?

Year	Amount (unit= ?)	Total Cost:
19		
19		
19		
19		
19		
19		

Is infant formula or other milk given to newborns?

Yes_____ No____

If yes, when is it given?

Routinely _____
When requested by M.D. _____
Other (describe) _____

_____

Does the hospital purchase infant formula? Yes_____ No_____
If yes, how much and at what cost?

Year	Amount (Unit=kg/lb)	Total Cost:
19		
19		
19		
19		
19		
19		

Is it provided free to the hospital? Yes_____ No_____
By what companies _____ How much is supplied?

Year	Amount (Unit kg/lb)
19	
19	
19	
19	
19	
19	

Is formula distributed to mothers free when they leave the hospital?
Yes_____ No_____ If yes, explain

_____

_____

Do mothers need to buy it for use in the hospital? Yes___ No____
At what cost?

Where purchased	Amount (Unit=kg/lb)Cost

How many bottles does the hospital purchase?

Year	Number of bottles	Cost/bottle	Total Cost
19			
19			
19			
19			
19			
19			

Is oxytocin used to contract the uterus in the postpartum period?
Yes____ No_____ If yes, when?

Routinely _____
Other (Describe)

What is the cost per year for oxytocin (metergine,etc)?

Year	Amount (unit= ?)	Cost
19		
19		
19		
19		
19		
19		

6. Have there been any changes within the hospital that affected breastfeeding in recent years? Yes_____ No_____ If yes, what changes?

	Change	
Explanation	When	
a) Rooming-in		
b) Use of glucose		
c) Use of infant formula		

d) Distribution of formula to mothers

e) Other (describe)

If there have been changes, please answer these questions:

a) Rooming-in

Did your institution have to make any changes in the physical structure to permit rooming-in? Yes _____ No _____

If yes, what changes were made?

_____

_____

How much did this cost? _____

Date changes were made _____

How many nurses/aides worked in the neonatal nursery during a typical shift before rooming-in?

_____ nurses _____ aides

After the changes, how many worked in the neonatal nursery?

_____ nurses _____ aides

How many nurses/aides worked in the postpartum ward during a typical shift before rooming-in?

_____ nurses _____ aides

After the changes, how many worked in the postpartum ward?

_____ nurses _____ aides

Were there any other changes made (change in purchase of beds, cribs, etc). Yes_____ No_____

How much did this cost?

Were there any procedural changes (such as shortened time between delivery and rooming-in, infants kept with mothers in bed or in cribs?)

What was the cost to do these changes? _____

Return to:

Ruth Levine
BREASTFEEDING PROMOTION COST SURVEY
Center to Prevent Childhood Malnutrition
7200 Wisconsin Avenue
Suite 204
Bethesda, MD 20814
U.S.A.

THANK YOU!