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# APPLICATION OF THE "GUIDE TO ASSESSING THE ECONOMIC VALUE OF BREASTFEEDING" IN EL SALVADOR AND SUGGESTIONS FOR FUTURE MODIFICATIONS TO THE GUIDE


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## I. PURPOSE

The purpose of this report is to describe specific aspects of the methodology used by our team in preparing the *Analysis of the Economic Value of Breastfeeding in El Salvador* which represent modifications to the approach contained in *The Guide to Assessing the Economic Value of Breastfeeding: A Workbook for Policymakers* (prepared by Ruth E. Levine, Ph.D., for the Center to Prevent Childhood Malnutrition, 1991). We also comment on how we took into account recommendations for modifying the guide that were made by Dr. Jose Mora based on his field test of the guide in Guatemala. Based on our revised methodology for analyzing the economic value of breastfeeding, we make several suggestions for how the guide could be revised in the future.

## II. MODIFICATIONS TO THE GUIDE RECOMMENDED BY DR. JOSE MORA

The team carefully reviewed the report prepared by Dr. Jose Mora[1] in order to incorporate in the El Salvador analysis, his observations on the limitations of the current guide and recommendations for modifying it.

The principal recommendations made by Dr. Mora for modifying or expanding upon the methodology outlined in the guide can be summarized as follows:

- Use the WHO formula to convert data on two-week prevalence of diarrhea and acute respiratory infections (e.g., from two-week recall surveys) to annual incidence of diarrhea and acute respiratory infections
- Differentiate acute respiratory infections as upper and lower respiratory infections
- Refine the calculation of the costs to the public sector of excess morbidity and mortality to take into account costs of both ambulatory treatment and hospitalization
- Add estimation of household costs from bottle feeding and excess morbidity and mortality to the analysis
- Expand analysis to include estimations of costs and effects of increased investment in breastfeeding promotion
- Revise or explain the methodology for estimating averted fertility attributable to breastfeeding and add to the analysis the costs to the public sector of family planning interventions required to compensate for the births not being averted due to suboptimal breastfeeding.

Our analysis of the economic value of breastfeeding in El Salvador included all of these suggested changes, with one exception. Because of the hypothetical nature of a package of family planning interventions that would be needed (but are not now being provided) to compensate for suboptimal breastfeeding in El Salvador and because of the lack of national data on the costs and effectiveness of family planning interventions (particularly scaled up interventions that would be needed to prevent births not being averted due to the current prevalence of suboptimal breastfeeding practices), we opted not to try to incorporate costs of family planning interventions required to compensate for suboptimal

[1] Mora, Jose O., Results of the Field Test in Guatemala of the Workbook "Guide to Assessing the Economic Value of Breastfeeding", LAC Health and Nutrition Sustainability, URC/ISTI, October 1991.

breastfeeding. Instead, we estimated direct benefits to the public sector for the costs associated with delivery care for the births averted due to breastfeeding.

## III. ADAPTATIONS TO THE GUIDE WHICH WERE APPLIED IN THE EL SALVADOR ANALYSIS

### Use of Net Benefits Analysis

The current guide does not attempt to relate the estimation of costs and savings related to breastfeeding, nor does it attempt to quantify the full range of benefits from current breastfeeding practices. An alternative to the guide's approach that was intuitively appealing to the El Salvador team was the estimation of the economic benefits and costs associated with present levels of breastfeeding to derive the net benefits (total benefits minus total costs) of current efforts to promote optimal breastfeeding. The calculation of net benefits permits the integration of several pieces of information covered in the guide into a single figure which neatly sums up the fact that breastfeeding promotion makes economic sense--i.e., it saves more than it costs.

In order to estimate the benefits of the current level of breastfeeding in El Salvador, it was necessary to compare the excess morbidity and mortality and averted births attributable to the current prevalence of breastfeeding with those that would be expected to occur in the absence of breastfeeding. The benefits of current breastfeeding levels in El Salvador were then defined as the difference between the current effects and those under a scenario of no breastfeeding whatsoever.

### Boundaries of the Analysis

In order to provide policymakers in the two major public sector health care delivery institutions in El Salvador with information that could most directly contribute to their decision making regarding investments in the promotion of breastfeeding, we limited our analysis to those sources of benefits and costs that accrue directly to the Ministry of Health (MSPAS) and the Social Security Institute (ISSS). Other costs and benefits to the Government of El Salvador as a whole (e.g., tax revenue from in-country manufacture of breast milk substitutes, debt service related to importation of breast milk substitutes) were excluded from the benefit/cost analysis because they were felt to be exceedingly difficult to quantify. In addition, these macroeconomic concerns are beyond the direct sphere of influence of public health authorities. That is, the authors felt that decision making at MSPAS and ISSS would be most persuaded by an analysis which centered on costs and benefits that relate directly to their respective institutions, rather than economic considerations which do not directly affect them.

Also, as a practical matter, the appropriate boundaries for a full "public sector" analysis are not clearcut, since it is possible to broaden the scope of the calculations to include many economic linkages between breastfeeding promotion or production, distribution or sale of breastmilk substitutes and the government. In contrast, using as the boundaries of analysis direct linkages to MSPAS and ISSS proved quite feasible and straightforward.

As an adjunct to the main analysis, the report does mention other sources of benefits and costs to the larger public sector but without quantifying them. We also estimated direct costs to Salvadoran households of suboptimal breastfeeding practices in terms of the costs of breastmilk substitutes and of treatment sought for excess episodes of diarrhea and acute respiratory infections. The latter estimates were felt to be useful to draw attention to the sizeable economic benefits of breastfeeding for individual households.

## Comparison of Current Situation with an Intervention Scenario that Results in Improved Breastfeeding Practices

To illustrate the economic return on investing in activities to increase the prevalence of optimal breastfeeding, the El Salvador report estimates the costs and benefits of heightened activities by the public sector that could be expected to increase the prevalence of optimal breastfeeding. The higher level of breastfeeding prevalence to be obtained under the alternative scenario and the breastfeeding promotion activities that were costed were hypothetical in nature and based loosely on experiences in other countries of the region. The net benefits of the additional investment in breastfeeding promotion were calculated as the additional benefits minus the additional costs of a more active breastfeeding promotion intervention (i.e., additional to the current levels of benefits and costs).

## Calculation of Excess Morbidity and Mortality Attributable to Suboptimal Breastfeeding

Based on a review of the epidemiological data from which were derived the multipliers presented in the guide for attributing excess diarrhea and acute respiratory infections morbidity and mortality to suboptimal breastfeeding, the formulas and estimates of attributable risk used to calculate the number of morbidity episodes were revised. A thorough discussion of the modifications made and the assumptions and rationale underlying them is presented in Annex 1[2]. Among other changes, the El Salvador analysis distinguished between upper and lower respiratory infections in calculating excess illness episodes. The availability of relevant data for El Salvador also permitted calculation of attributable morbidity and mortality based on the actual prevalence of suboptimal breastfeeding among Salvadoran infants, rather than through use of the multipliers (which represent risks estimated for "high", "medium" or "low" prevalence of exclusive breastfeeding under 6 months of age).

The net effect of these changes was to reduce substantially the proportion and consequently, number of excess episodes of diarrhea, upper respiratory infections and lower respiratory infections attributable to suboptimal breastfeeding. A comparison of the "% of episodes attributable to suboptimal breastfeeding" using the multipliers in the guide versus the formulas used for the El Salvador analysis is shown in Table 1.

[2] Note that some calculations shown in Annex 1 for El Salvador differ slightly from those used in the actual El Salvador breastfeeding economic analysis due to the fact that the team ended up using slightly different numbers for some indicators based on additional information obtained after Annex 1 was written.

**TABLE 1: Comparison of % of Episodes Attributable to Suboptimal Breastfeeding The Guide vs. El Salvador Approach**

| EXCESS MORBIDITY | | Current (low prevalence) | Alternative (medium prevalence) |
|---|---|---|---|
| Diarrhea | Guide | 50% | 35% |
| | El Salvador | 21% | 15% |
| Acute respiratory infections | Guide | 43% | 29% |
| | El Salvador | URI: 16%<br>LRI: 43% | URI: 11%<br>LRI: 35% |
| EXCESS MORTALITY | | Current (low prevalence) | Alternative (medium prevalence) |
| Diarrhea | Guide | 76% | 58% |
| | El Salvador | 65% | 54% |
| Acute respiratory infections | Guide | 35% | 23% |
| | El Salvador | 32% | 25% |

**Calculation of Averted Fertility Attributable to Suboptimal Breastfeeding**

The approach we used to estimate the number of births averted due to breastfeeding under both the current and the alternative intervention scenarios was based on predicted changes in the total fertility rate as a result of variations in the length of the period of postpartum infecundability (due to differences in postpartum amenorrhea and abstinence), holding constant the actual prevalence of contraception in El Salvador[3]. The aggregate use-effectiveness of contraception in El Salvador (an average of the prevalence of use of specific contraceptive methods, weighted by the estimated effectiveness of each method) was calculated and figured into the calculation of the total fertility rate. Annex 2 contains a description of the method used and the calculations performed to estimate the births averted each year due to breastfeeding under the current and alternative scenarios.

The net effect of using this approach rather than the multipliers in the guide was to drastically reduce to what we believe are more realistic levels, the number of births averted due to

[3] Stover, J., J.C. Knowles, A.E. Wagman and D.L. Nortman (1993). Target-Costs: A Model for Projecting the Family Planning Service Requirements and Costs to Achieve Demographic Goals. Methodology and manual prepared by the Futures Group funded by the U.S. Agency for International Development under the OPTIONS II Project, Glastonbury, CT.

**TABLE 2: Comparison of % of Births Averted Because of Breastfeeding**
(Total Number of Births Averted)
The Guide vs. El Salvador Approach

| | Current (low prevalence) | Alternative (medium prevalence) |
|---|---|---|
| Guide | 60% (90,720) | 80% (120,960) |
| El Salvador | 30% (45,556) | 37% (55,767) |

breastfeeding. The percent and number of births averted under the approach used for El Salvador are compared with the results using the guide's multipliers in Table 2.

## IV. SUGGESTIONS FOR FUTURE MODIFICATIONS TO THE GUIDE

The team recommends that the guide be revised to introduce the methodological changes applied in the El Salvador analysis, as summarized below. Adoption of these suggestions will necessarily involve changing the guide's format.

### Adopt Net Benefits Approach and Limit Analysis to the Public Health Sector

We believe that the calculation of net monetary benefits (economic benefits less costs) and limiting the sources of benefits and costs to those which accrue directly to the major public sector health institutions provide a more meaningful framework for the economic analysis than the presentation currently outlined in the guide. The El Salvador analysis demonstrates that this approach is also quite feasible and in some respects easier to complete than are certain indicators now in the guide that relate to costs associated with the manufacture and importation of breast milk substitutes.

### Expand the Analysis to Compare the Current Situation with a Potential Future Scenario of Increased Investment in Breastfeeding Promotion

We believe that the guide needs to examine the likely costs and benefits or effects of investing additional resources in the promotion of optimal breastfeeding practices in the country, since such information is essential for convincing decision makers of the value of such investment in a climate of scarce resources. A section following the El Salvador example could be added to the guide to accomplish this.

### Refine Calculations of Excess Morbidity and Mortality and Averted Fertility

The estimation of excess morbidity and mortality in the guide should be revised to incorporate the recommendations made by Ellen Piwoz (see Annex 1). Specifically, the guide should be revised to: 1) correct the formulas and relative risk estimates used to calculate morbidity multipliers (i.e., the proportions of total episodes attributable to suboptimal breastfeeding); 2) present a greater choice of multipliers for the proportion of diarrhea and acute respiratory infections (ARI) morbidity and mortality attributable to suboptimal breastfeeding to provide options for high, medium and low partial breastfeeding for infants 6-11 months for each category of exclusive breastfeeding under 6 months (resulting in nine different feeding patterns), OR alternatively, provide instructions for calculating the attributable risk of diarrhea and ARI morbidity and mortality using the country's actual prevalence of exclusive breastfeeding 0-5 months and of partial breastfeeding 6-11 months, as was done for El Salvador; 3) determine whether there is an accepted demographic pattern with respect to the distribution of infants between the 0-5 and

6-11 months age groups, and if so, incorporate this distribution in the formulas; 4) distinguish between upper and lower respiratory infections in the calculations; and 5) include best estimates of diarrhea and respiratory infection incidence based on regional data, to be used for countries where incidence and prevalence data are not available.

Similarly, the multipliers used to estimate the number of births averted due to breastfeeding should be revised to apply the method in Annex 2, which incorporates data on contraceptive prevalence to calculate averted births attributable to breastfeeding.

**Consider Linking the Guide to a Computer-Based Exercise**

The impact of the analysis of the economic value of breastfeeding on policymakers could be significantly enhanced if the analysis were linked to a computer-based graphics presentation, particularly one which allowed viewers to modify key variables.

The PROFILES computer-based modules developed by the A.I.D. Office of Nutrition-funded Nutrition Communications Project offer one such exercise. The purpose of the PROFILES computer program is to provide tools for nutrition advocacy, by illustrating (graphically) the economic and health impacts of undernutrition and the potential benefits of programs to improve feeding practices and nutritional status. The statistical models that form the basis of the program were constructed from available epidemiologic data, including the studies cited in Annex 1. The most recent PROFILES program (version 2.0) is interactive, meaning that users can manipulate variables in the models to reflect different nutrition conditions and program options. Many of the costs addressed in the economic analysis of breastfeeding could be graphically displayed using the PROFILES software, to create slides, overheads, or a computer-driven presentation.

Serious consideration should be given to combining a revised version of the guide and its resulting reports with a PROFILES presentation to aid advocacy efforts in locations where the economic analysis is performed. PROFILES' models and capabilities should be explored in order to determine how the guide and the software could be coherently combined to influence policy decisions. By the same token, given the above recommendations about refining the guide's approach to calculating excess morbidity and mortality and births averted, it would be advantageous to create spreadsheets which facilitate these calculations.

In addition, the inclusion of guidelines on how the Target Program or spreadsheets can be used to calculate the impact of breastfeeding promotion activities on family planning program goals would be beneficial.

# ANNEX 1

## The Validity and Reliability of Morbidity and Mortality Calculations on the Economic Value of Breastfeeding and their Application to El Salvador

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## ACRONYMS

| | |
|---|---|
| ARI | Acute respiratory infection |
| DHS | Demographic and Health Surveys |
| IMR | Infant mortality rate |
| LRI | Lower respiratory infection |
| RR | Relative risk |
| URI | Upper respiratory infection |
| USAID | US Agency for International Development |

## Introduction

This report reviews the assumptions and formulas employed in *The Guide to Assessing the Economic Value of Breastfeeding: A Workbook for Policymakers* (Center to Prevent Childhood Malnutrition, 1991) to estimate the excess morbidity and mortality attributable to sub-optimal breastfeeding practices in developing countries. This review is part of a larger effort to estimate the public sector costs of sub-optimal breastfeeding practices, and the expected health and economic benefits of a comprehensive program to improve them in El Salvador.

The report is divided into four sections. The first section reviews the assumptions and formulas used in the calculations to estimate excess morbidity from sub-optimal breastfeeding practices. The second section analyzes the mortality assumptions and formulas. Section III shows the actual workbook calculations using data from El Salvador, and section four includes recommendations for modifications to the morbidity and mortality sections of the workbook.

## I. Morbidity Assumptions and Formulas

### A. Background

Estimations of the excess morbidity attributable to improper breastfeeding practices are based on the results of longitudinal studies conducted by Brown *et al.* (1989) in a peri-urban, low-income population in Lima, Peru.

The sample for this study included 153 full-term infants, with birth weights $\geq$ 2500 g, who were followed from birth to 12 months of age. Infants were visited three times a week to collect information on the presence or absence of a variety of diseases/symptoms -- including diarrhea, fever, runny nose, and other characteristics -- on the day of the home visit and the one or two preceding days.

Usual feeding practices were ascertained through a monthly questionnaire administered to the infants' mother or primary caretaker at the end of each month. On the basis of this questionnaire, infants were classified as 1) exclusively breastfed (consuming only breastmilk), 2) breastfed and consuming non-milk liquids (waters, teas, etc.), 3) breastfed and consuming non-human milks (can include non-milk liquids but no solid foods), 4) breastfed and consuming solid foods (can include non-human milks and non-milk liquids), and 5) no longer breastfed during the preceding month.

The study design and diagnosis methods are described in numerous publications (*e.g.*, Lopez de Romana *et al.*, 1989; Black *et al.*, 1989; Brown *et al.*, 1989). The reported feeding data are believed to be accurate, based on monthly comparisons with observed dietary intakes by study infants (Piwoz, 1992).

Tables contained in the paper by Brown *et al.* (1989) summarize the number of 1) observation days, 2) episodes of diarrhea, and 3) days with diarrhea and other infections for infants in each feeding category according to their age (0-2.9, 3-5.9, 6-8.9, 9-11.9 months). Relative risks (using the diarrhea episode data) and prevalence rate ratios (using data on the number of days with other illnesses) are also calculated, using the incidence and prevalence of disease among exclusively breastfed infants (< 6 months) and still breastfed infants ($\geq$ 6 months) as the reference categories. Data relevant to this report are shown in Tables 1 and 2.

## B. Workbook Assumptions

The workbook uses the relative risk data presented by Brown *et al.* to calculate the "episode multipliers" shown on page 10 (of 0.23, 0.35, 0.50). These multipliers were generated using additional information from Demographic Health Surveys (DHS) conducted in Burundi, Egypt, and Mexico regarding the percentages of children who are exclusively breastfed, partially breastfed, and no longer breastfed in the first and second semesters of infancy (0-5 and 6-11 months). These three countries were believed to represent feeding patterns in countries of high ($\geq$ 60%), medium (30-60%), and low (< 30%) prevalence of exclusive breastfeeding in early (< 6 months) infancy (workbook page 4).

The **assumptions** used to calculate the multipliers are: 1) data from Peru on the relationship between feeding mode and disease can be extrapolated to other settings; and 2) the prevalence of partial breastfeeding and complete weaning in a population is consistently related to the prevalence of exclusive breastfeeding in infants < 6 months (explained below). In addition, it is also assumed that 3) 50% of the infant population is < 6 months (and 50% is older).

With respect to the second assumption, on the basis of DHS data from the three countries noted above, it is specifically assumed that:

1) **if** $\geq$ 60% of infants < 6 months old are exclusively breastfed (high prevalence):

   **then** 86% of non-exclusively breastfed infants < 6 months are partially breastfed (also consuming non-milk liquids, non-human milks, and/or solid foods), 14% of non-exclusively breastfed infants < 6 months are no longer breastfed, and 7% of infants 6-11.9 months are no longer breastfed.

2) **if** 30-60% of infants < 6 months old are exclusively breastfed (medium prevalence):

   **then** 77% of non-exclusively breastfed infants < 6 months are partially breastfed (also consuming non-milk liquids, non-human milks, and/or solid foods), 23% of non-exclusively breastfed infants < 6 months are no longer breastfed, and 19% of infants 6-11.9 months are no longer breastfed.

3) **if** < 30% of infants < 6 months old are exclusively breastfed (low prevalence):

   **then** 61% of non-exclusively breastfed infants < 6 months are partially breastfed (also consuming non-milk liquids, non-human milks, and/or solid foods), 39% of non-exclusively breastfed infants < 6 months are no longer breastfed, and 52% of infants 6-11.9 months are no longer breastfed.

Note that whereas during the first 6 months of life there are two categories of sub-optimal breastfeeding (partial breastfeeding, no breastfeeding), during the second 6 months, sub-optimal breastfeeding is described one way (no breastfeeding).

## C. Workbook Formulas

Assumptions 1-3 create the following formulas to calculate 1) the relative risk of morbidity, and 2) the excess morbidity attributed to sub-optimal breastfeeding practices in countries with high, medium, and low exclusive breastfeeding prevalences. It is useful to bear in mind that whereas the total relative risk of illness ($RR_{total}$) is mainly a function of the prevalences of complete weaning and partial breastfeeding among sub-optimal breastfeeders in the three reference countries, the risk attributable to

poor breastfeeding practices also takes into account the percent of the three reference populations following the desirable feeding behavior, as shown below:

1) **Relative risk (RR) of diarrheal/ARI morbidity:**

**if high exclusive breastfeeding prevalence**

$$RR_{total,h}=[\{0.86(RR_{pb,\ 0\text{-}5\ mo}) + 0.14(RR_{nb,\ 0\text{-}5\ mo})\} + 1.0(RR_{nb,\ 6\text{-}11mo})]*0.50$$

**if medium exclusive breastfeeding prevalence**

$$RR_{total,\ m}=[\{0.77(RR_{pb,\ 0\text{-}5\ mo}) + 0.23(RR_{nb,\ 0\text{-}5\ mo})\} + 1.0(RR_{nb,\ 6\text{-}11mo})]*0.50$$

**if low exclusive breastfeeding prevalence**

$$RR_{total,\ l}=[\{0.61(RR_{pb,\ 0\text{-}5\ mo}) + 0.39(RR_{nb,\ 0\text{-}5\ mo})\} + 1.0(RR_{nb,\ 6\text{-}11mo})]*0.50$$

where: pb=partial breastfeeding and nb=no breastfeeding and RR taken from Brown *et al.*, 1989

2) **Excess morbidity attributable to sub-optimal breastfeeding**

[(% of population sub-optimally breastfeeding)*($RR_{total}$ -1)] / [(% of population sub-optimally breastfeeding)*($RR_{total}$ - 1)] + 1

where: % of population sub-optimally breastfeeding equals 22%, 38%, and 64% for high, medium, and low breastfeeding, respectively.

These percentages are derived from the DHS country data described earlier, where 64%, 44%, and 24% of the infant population < 6 months were exclusively breastfed. Thus, if there is a population of 200 infants (100 < 6 months, 100 $\geq$ 6 months), then in high exclusive breastfeeding countries, 64+93/200 or 78% are optimally breastfeeding and 22% are sub-optimally breastfeeding.

### D. Evaluation of the Assumptions

1) **Use of the Peruvian Data**

Extrapolation of the Peruvian study results to estimate excess risk and episodes of illness in other populations is limited by 1) the relatively homogeneous environment in which the study was carried out, and 2) the fact that risk estimates are not adjusted for the effects of potential confounding variables.

For example, the introduction of liquids and solids to the diet of young infants increases their risk of diarrhea in populations where hygiene and sanitation are deficient and these foods become pathogenically contaminated. The community where this study was carried out did not have electricity, piped water, or sewerage services, and animals were commonly observed defecating in and around dwelling areas (Lopez de Romana *et al.*, 1987). The protective effect of breastfeeding against diarrhea may not be as great in low-income populations that also include homes with better hygiene and sanitary environments (and thus lower risk of food and liquid contamination).

Studies have shown that the incidence of upper respiratory infections is comparable in developed and developing countries (Pio, 1988). Environmental conditions that increase risk of respiratory morbidity include household crowding and indoor air pollution (Stansfield, 1987). Both of these conditions vary between households. Therefore, the homogeneity problem described above is not likely

to have as great an effect on the relationship between breastfeeding and ARI incidence as might be expected with the relationship between breastfeeding and diarrhea.

Given these limitations, it is important to compare the risk estimates obtained in the Peruvian study with similar data derived from studies in other low-income populations. Available data are described below.

Diarrhea

Published data on the relative risk of diarrhea and other infections for infants following different feeding practices are relatively rare. Comparisons between existing studies are further complicated by variation in the definitions of feeding practices used by different investigators. Results from four prospective studies that reported relative risk of diarrhea by feeding pattern and age are summarized in Table 3.

Several important differences among the studies shown in Table 3 must be mentioned. In the Philippines, for example, investigators visited homes every two months and measured diarrheal incidence in the last seven days by feeding practices during that time period. In Brazil, incidence rates were based on weekly visits, but the definition of exclusive breastfeeding also included consumption of waters, teas and juices. In both the Philippines and Brazil studies, risk estimates are adjusted for family income and other significant covariates. The Bangladesh study closely parallels the Peru study design, but no Bangladeshi infants were completely weaned before one year, so risk comparisons for non-breastfed versus breastfed infants are not possible.

Even in light of these differences, it is important to note that the relative risk estimates for diarrhea by feeding pattern obtained in the Peru study are not markedly different from those obtained in other locations. It is recognized that the number of Peruvian infants on which these estimates are based is small. **However**, given the lack of alternative sources of data and the general nature of the estimates being produced in the workbook, the use of the Peruvian diarrhea risk data for this exercise does not seem unreasonable at the present time.

Respiratory Infection

Although nutritional status is considered a risk factor for ARI morbidity, few studies comparing ARI risk by breastfeeding status were identified. Of the available studies, most have examined or reported the protective effect of exclusive breastfeeding in contrast to no breastfeeding. Several studies in developed countries (*e.g.*, Fergusson *et al.*,1981) have found no association between breastfeeding status and respiratory infection incidence, after adjusting for known risk factors, such as maternal smoking and household crowding or environment.

In a study among Asian Indian infants, the incidence of infection in 35 infants who were exclusively breastfed for at least two months was compared with the incidence of infection in 35 matched-control infants who were fully weaned and formula-fed. During their first year of life, formula-fed infants had nearly twice as many episodes of ARI (RR=1.91), 2.5 times more episodes of middle ear infection, and four times as many episodes of pneumonia (8 vs. 2) compared to breastfed infants (Chandra, 1979).

In a prospective study in Boston, non-breastfed infants were 2.0 times more likely to have $\geq$ 3 episodes of middle ear infection during infancy than infants who were breastfed (Teele *et al.*, 1989). In a retrospective study among Pima and Papago Indians in Arizona, infants who were exclusively breastfed for at least four months were 1.6 to 2.1 times less likely to seek treatment for upper respiratory infection

between the ages of 0-4 and 5-8 months, respectively, than infants who were never breastfed, and after adjusting for potential confounding variables (Forman *et al.*, 1984).

Although the magnitudes of these estimates are roughly comparable to those observed in Peru, use of the Peruvian data to calculate excess respiratory infection episodes is complicated by the fact that investigators in the Peruvian study did not present respiratory incidence data. This was because of the difficulties in distinguishing between repeated (old and new) episodes of respiratory infection.

There are three possibilities for handling this problem. In the first, episode rates are directly estimated from the prevalence data by assuming that all illness episodes are of equal duration. This is what was done in the original workbook calculations. This method will be biased when there are differences in illness duration for infants following different feeding practices (as is the case with diarrhea).

The second way of handling the problem is to assume that optimally breastfed infants have shorter and less severe episodes of ARI than sub-optimally breastfed infants. The rationale for assuming this is inverse association between nutritional status and ARI morbidity (Stansfield, 1987). Unfortunately, there are no data to available to estimate average ARI episode duration among exclusively breastfed, partially breastfed, and non-breastfed infants. In Huascar, Peru, the average duration of diarrhea episodes was 1) 65% shorter among exclusively breastfed infants < 6 months compared to partially breastfed infants and non-breastfed infants of the same age, and 2) 80% shorter among partially breastfed infants 6-11 months compared to non-breastfed infants of the same age. It might also be reasonable to assume that ARI episodes are 65% shorter in exclusively breastfed infants < 6 months and 80% shorter among partially breastfed infants 6-11 months. These assumptions were used in the calculation of ARI relative risk estimates shown in Table 2. Note that there is no increased risk of URI among 6-11 month old non-breastfed infants when this assumption is applied.

Alternatively, the workbook can shift its focus from excess episodes to excess number of days ill. Such a shift would require information on the number of days ill with diarrhea and respiratory infections per infant per year, or the average number of illness episodes per infant per year and their average duration. The advantages and disadvantages of using days ill rather than episodes for calculating the excess morbidity and its economic implications are discussed in Section IV.

2) **Consistent relationship between exclusive breastfeeding and other feeding practices**

As noted above, the multipliers used in the workbook are based on the assumption that the prevalence of completely weaned infants varies inversely and consistently with exclusive breastfeeding. For example, in countries where exclusive breastfeeding is uncommon (low), it is assumed that 39% of infants < 6 months olds will already be completely weaned from the breast. This declines to 23% and 14% for countries with medium and high exclusive breastfeeding prevalences.

The validity of this assumption is questionable. Decisions about exclusive breastfeeding are probably influenced by very different conditions than those that influence the decision to discontinue nursing entirely. Early supplementation is extremely common worldwide, even in populations where the majority of infants are breastfed for more than one year. In the Peruvian study mentioned above, for example, fewer than 5% of infants were exclusively breastfed until 4 months of age, yet over 80% were still breastfed at one year of age.

In El Salvador, the family health survey shows a very low prevalence of exclusive breastfeeding (< 15% of all children < 6 months and only 5% of 6 month old children), but only 15.7% of non-exclusively breastfed infants < 6 months and 27.6% of infants 6-11 months were no longer nursing. The percentages used in the assumptions and formulas are 39% and 52%, respectively. Since cessation

of breastfeeding poses the greatest increase in risk of diarrhea and other illnesses, overestimation of complete weaning rates introduces a potentially high source of error in these computations.

Most countries with data on the prevalence of exclusive breastfeeding will also have information on percent of children no longer breastfed and the percent partially breastfed at different ages. It is therefore recommended that the workbook be revised so that multipliers take into account varying prevalences of complete weaning during infancy for countries of high, medium, and low exclusive breastfeeding. Specific recommendations are offered in Section IV.

3) **Equal distribution of children 0-5 and 6-11 months**

The workbook assumes that the infant population will be evenly divided into two 6-month groups. This assumption will introduce a small bias into the morbidity estimates because, in stable populations where the mortality rate does not fluctuate over the year, there are likely to be more children 0-5 months than 6-11 months of age. The direction of this bias is likely to be downward (i.e., underestimation of excess morbidity) because the increased risk of illness due to sub-optimal breastfeeding practices is greatest during the first semester of infancy.

In El Salvador, the distribution of infants in the Family Health Survey was 53% < 6 months compared to 47% who were 6-11.9 months of age. Demographers should be consulted regarding the usual or expected percentages of infants in these two age categories. Modification to the workbook formulas should be made if consensus on this breakdown can be reached.

4) **Other issues/modifications**

Risk estimates

The workbook tries to estimate the number of excess episodes of illness attributable to sub-optimal feeding practices but the risk estimates used to calculate the multipliers are based on prevalence rate ratios which would indicate the excess number of days ill.

This error creates a significant inflation in the multiplier. For example, as shown in Table 1, the RRs of diarrhea (incidence) for partially breastfed and non-breastfed infants < 6 months are 1.41 and 2.59, respectively, compared to the much higher prevalence rate ratios[4] used in previous calculations. **Therefore**, if the workbook seeks to estimate excess episodes, then multipliers should be calculated using the relative risks (or incidence data). If the workbook shifts its emphasis to excess days ill (as mentioned earlier), then prevalence data may be used.

Estimating episodes of illness/child/year

The workbook requires estimates of the average number of episodes of diarrhea and respiratory infection per infant per year to compute excess morbidity. For most countries, however, such data are not readily available. In computations for Guatemala and Belize, at least one of the variables had to be estimated from cross-sectional survey data on the percent of children with diarrhea in the last 14 days.

Estimating an annual disease incidence rate per child per year from two week recall data is not simple nor necessarily accurate. Seasonal variation affects period prevalence estimates of disease and the

[4]Note that to obtain estimates for the 0-5 month period, the workbook took crude averages of illness rates for infants 0-2 and 3-5 months of age. The present paper uses the raw data to calculate incidence and prevalence rates for the 0-5 month period because the number of observations available during the 0-2 and 3-5 month period are not equal.

accuracy of extrapolations to longer time intervals. Comparisons of incidence and prevalence rates derived from reports on duration of diarrhea and time since last episode of diarrhea also suggest significant under-reporting of distant episodes (4-10 days ago) and possible over-reporting of recent (0-3 days) disease (Ties Boerma *et al.*, 1991). On the other hand, comparisons of diarrheal incidence rates derived from longitudinal studies found a positive association between incidence estimates and frequency of disease surveillance (Bern *et al.*, 1992).

The World Health Organization (1992) currently recommends the following formula for calculating 2-week incidence rates ($I_{14\,d}$) from 2-week prevalence ($P_{14\,d}$) data:

$I_{14\,d} = P_{14\,d} * 14/(14+d)$ where d=average duration of an episode

Extrapolation to the entire year from 2-week incidence can be done by multiplying $I_{14\,d}$ by 26 if no seasonal variation is expected, or by dividing the $I_{14\,d}$ by the proportion of annual disease episodes expected to have occurred during the 2-week recall period. The average number of days with diarrhea per child per year is calculated by multiplying ($I_{14\,d}$ * d). Portions of the WHO manual pertaining to these calculations are found in Appendix A. These instructions should be added to the workbook to assist users in making the correct calculations. Corrections for seasonality may not be necessary for the workbook's purposes unless survey data were collected during a period of peak or very low disease prevalence.

In some instances data on disease prevalence and incidence may not be available or may be deemed to be inaccurate. Given that conversion of 2-week prevalence rates to annual incidence rates requires numerous assumptions, a simplifying alternative could be to offer either a single incidence estimate or a menu of predetermined levels of diarrhea or ARI incidence (low, medium, high) based on available worldwide data. A recent review of ARI incidence in 9 countries found a median incidence 6.86 episodes of ARI and 0.96 episodes of lower respiratory infections (LRI) per child per year for children < 3 yrs (Selwyn *et al.*, 1990). Median estimates would likely be somewhat higher if only infants are included. A review of diarrheal disease incidence in 18 studies (Bern *et al.*, 1992) found a median incidence of 3.9 episodes per infant per year in developing countries.

Including all infants in risk calculations

Workbook calculations of excess morbidity among sub-optimally breastfed infants assume that all infants are at equal risk of diarrheal and respiratory infection. As noted previously, the Peru study was conducted in a population with limited access to clean water and sanitation. Research suggests that although breastfeeding is associated with reductions in morbidity in industrialized countries (Cunningham *et al.*, 1991), the protective effect of breastfeeding against morbidity and mortality varies with and depends on hygiene and environmental conditions (Habicht *et al.*, 1988).

Given these conditions, it is likely that applying the risk estimates from the Peruvian study to an entire population of infants from another country will result in an overestimation of excess morbidity because not all infants will be adversely impacted by sub-optimal breastfeeding, or impacted to the same degree, as the disadvantaged Peruvian children. One option for handling this problem is to multiply excess morbidity estimates by the population at increased risk of infection from sub-optimal breastfeeding rather than the entire infant population (*i.e.*, exclude the % of the population that is non-poor). This modification requires assumptions about socio-economic status and will exclude the excess morbidity among non-poor infants who, in fact, may be at increased risk. This recommendation is offered, however, to provide a more conservative approximation in the event of criticism that the existing workbook approach overestimates the excess morbidity.

## II. Mortality Assumptions and Formulas

### A. Background

Estimations of the excess mortality attributable to improper breastfeeding practices are based on the results of a population-based case-control study conducted in two urban areas of southern Brazil (Victora *et al.*, 1987). Cases (infant deaths) were identified through a weekly review of death certificates and hospital records. Infants with birth weights < 1500 g, with congenital abnormalities, who were not singletons, or were hospitalized for more the 15 days immediately after birth were excluded from the analyses. Two matched controls (N=714) were selected for each case (N=357). Matching was determined based on age and neighborhood of residence.

For cases (infant deaths), a detailed feeding history was obtained from the mother or deceased infant's primary caretaker. Special attention was given to recording the feeding mode just before the terminal illness and to establishing any association between ill-health and subsequent feeding changes. Feeding information for the controls was ascertained for the date when the matched case was last symptom-free. On the basis of this information, cases and controls were classified as 1) exclusively breastfed (could include water), 2) breastfed and consuming other milks, 3) breastfed and consuming non-milk liquids (besides only water), 4) breastfed and consuming other milks, liquids, and solids, 5) not breastfed and consuming other milks, and 6) not breastfed and consuming other milks, liquids, and solids. Infants who were completely weaned as a result of their life-threatening illness were classified in the appropriate breastfeeding category (1-4).

Relative risks for infant mortality from diarrhea, respiratory, and other infections were calculated by feeding mode. Estimates were adjusted for confounding variables, including infant age, birth weight, family social status (determined by employment of household head), maternal education, and family income when they were significant in the multiple logistic regression models. Differences in crude and adjusted RR estimates were sizeable (shown in Table III of the paper). Data relevant to this report are summarized in Table 4.

### B. Workbook Assumptions

The formulas used to calculate the mortality multipliers are the same as the formulas used for the morbidity multipliers. The assumptions are the same as those noted in the previous chapter: 1) data from Brazil on the relationship between feeding mode and mortality can be extrapolated to other settings; and 2) the prevalence of partial breastfeeding and complete weaning in a population is consistently related to the prevalence of exclusive breastfeeding in infants < 6 months (explained below). In addition, it is also assumed that 3) 50% of the infant population is < 6 months (and 50% is older).

There are two major differences between the Peruvian and Brazilian studies that influence the calculations of the workbook multipliers. These are 1) the Brazilian risk estimates are adjusted for potential confounding variables, and 2) the Brazilian estimates are presented for infants < 2 months and 2-11.9 months, instead of the age groupings 0-5.9 months and 6-11.9 months used in the workbook. Relative risks for these age groups were determined by averaging the available age-specific data (Huffman *et al.*, 1991). These averages are shown in Table 5.

### C. Evaluation of the Assumptions

#### 1) Use of the Brazilian Data

The data on relative risk of mortality by infant feeding mode are derived from the experience of a relatively small number of infants living in urban Brazil. The adjusted risk estimates observed in this

study are comparable to those observed in other studies, which examined infectious and non-infectious causes of death (summarized in Cunningham *et al.*, 1991).

It is important to note that relative risk of mortality for sub-optimally breastfed Brazilian infants was greatest in the first two months of life, in contrast to the rest of infancy. Data are presented two ways in the report: after adjusting for age and other covariates, and by age grouping (< 2, 2-11.9 months; see Table 4). Unfortunately, insufficient data are available to evaluate the assumptions used in the workbook to partition the relative risk of death by feeding mode into the age groupings of 0-5.9 and 6-11.9 months of age.

Similar calculations were made by Burkhalter (1992), however, for the PROFILES modeling software. Using his assumptions, the relative risks of diarrheal and ARI mortality among infants < 6 months were 4.2 and 1.9, respectively, for partially breastfed infants (compared to 3.0 and 2.0 in the workbook), and 16.0 and 3.4, respectively, for non-breastfed infants (compared to 18.0 and 2.5 in the workbook). In the PROFILES calculations, risk among older infants further depended on the nature of partial breastfeeding and are difficult to compare with the workbook computations.

Use of the adjusted mortality risk estimates derived from the Brazilian study does not seem unreasonable at the present time, given the lack of alternative data. Additional information is required to determine whether the risk estimates used in PROFILES (and derived from the same study) are more appropriate than the ones currently used in the workbook to calculate the mortality multipliers.

2) **Consistent relationship between exclusive breastfeeding and other feeding practices**

This assumption is the same as for the morbidity multipliers.

3) **Equal distribution of children 0-5 and 6-11 months**

This assumption is the same as for the morbidity multipliers.

## III. Excess Morbidity and Mortality in El Salvador

The excess morbidity and mortality due to sub-optimal breastfeeding practices are calculated using data obtained in the 1988 and 1993 Family Health Surveys and presented in the Infant Feeding Assessment in El Salvador (Betancourt *et al.*, 1993).

For these calculations, the following **data and assumptions** were used:

1) 19% of infant deaths are due to diarrhea and 16% of infant deaths are due to ARI (LRI).

2) IMR is 45/1000 and thus > 6,850 infants die each year (IMR * # live births=6,852).

3) infants suffer 5.8 episodes of diarrhea per year (based on two-week recall prevalence of 30.5% and estimated average duration of 5 days).

4) infants spend an average of 29 days per year with diarrhea (5.8*5; 8% of days).

5) infants suffer 8.9 episodes of ARI (URI+LRI) per year (based on two-week recall prevalence of 68.1% and estimated average duration of 14 days).

   - of these 8.9 episodes, 8.4 episodes are URI and 0.5 episodes are LRI.

- the division of URI and LRI episodes is based on data from longitudinal studies in Guatemala (reported in Mora, 1991).

- average duration of ARI among exclusively breastfed infants < 6 months is 9.1 days, and among partially breastfed infants 6-11 months is 11.2 days.

- average duration of ARI among all other infants is 14 days (see previous discussion).

6) infants spend an average of 125 days per year with ARI (8.9*14; 34% of days).

7) among infants 0-5.9 months, 14.9% are exclusively breastfed, 71.8% are partially breastfed, and 13.3% are completely weaned.

   - therefore, 84.3% of non-exclusively breastfed infants are partially breastfed and 15.7% are completely weaned.

8) among infants 6-11.9 months, 72.4% are partially breastfed, and 27.6% are completely weaned.

9) among infants 0-11.9 months, 58.3% are sub-optimally breastfed.

10) 53.3% of infants are 0-5.9 months and 46.7% are 6-11.9 months.

11) there are 152,250 infants in El Salvador (5.25 million people * 0.29 crude birth rate), and all are at risk of diarrhea and ARI due to sub-optimal feeding practices.

It is important to stress that the results of the calculations presented below are **estimates** (not predictions) of the morbidity and mortality in Salvadoran infants that may be attributable to improper breastfeeding practices, for the purposes of persuading policymakers of the need for and the potential benefits of programs to improve breastfeeding practices. As estimates, percentages used and results obtained should be presented in rounded numbers, so that readers do not assume an element of precision (or prediction) that does not exist. The percentages used and the results obtained from this exercise are not rounded in this report, however, so that the persons reviewing this draft and putting together the complete report on the economic value of breastfeeding in El Salvador can clearly see how each calculation is done and where each number comes from.

### A. Excess Morbidity Episodes - Diarrhea

The excess diarrheal morbidity episodes due to sub-optimal feeding practices are calculated using the above data and the formulas outlined in Section I.

1) **Relative risk for sub-optimally breastfed infants**

$$[\{0.843*(1.41) + 0.157*(2.59)\}*0.533] + \{(1.30)*0.467\} = \mathbf{1.46}$$

Thus, sub-optimally breastfed infants are 0.46 times more likely to develop diarrhea than optimally breastfed infants in this population.

2) **Risk attributable to sub-optimal breastfeeding**

$$\{0.583*(1.46-1)\} / \{0.583*(1.46-1)\}+1 = \mathbf{0.2115}$$

Thus, 21% of all infant diarrhea episodes may be attributed to sub-optimal feeding practices.

This is equivalent to 1.23 episodes per infant per year (the average of 5.8 episodes per infant per year*0.2115).

3) **Excess morbidity episodes due to diarrhea**

Sub-optimal breastfeeding accounts for > 180,000 episodes of diarrhea per year (1.23*152,250=187,268). Note that this assumes that all infants are at risk of diarrhea due to sub-optimal breastfeeding practices. If non-poor infants living in clean environments are not at risk, then excess episodes will be lower than this number (and can be approximated by multiplying 1.23 and the total population at risk).

**B. Excess Morbidity Episodes - Respiratory Infections**

1) **Relative risk for sub-optimally breastfed infants**

[{0.843*(1.40) + 0.157*(2.68)}*0.533] + {(1.00)*0.467}= **1.32 for URI**

[{0.843*(2.82) + 0.157*(3.64)}*0.533] + {(1.55)*0.467}= **2.30 for LRI**

Thus, sub-optimally breastfed infants are 0.32 times more likely to develop URI and 2.3 times more likely to develop LRI than optimally breastfed infants in this population.

2) **Risk attributable to sub-optimal breastfeeding**

{0.583*(1.32-1)} / {0.583*(1.32-1)}+1 = **0.1572 for URI**

{0.583*(2.30-1)} / {0.583*(2.30-1)}+1 = **0.4311 for LRI**

Thus, 16% of all infant URI episodes and 43% of all LRI episodes may be attributed to sub-optimal feeding practices.

This is equivalent to 1.3 episodes of URI (8.4*0.16) and 0.22 episodes of LRI (0.5*0.43) per infant per year.

3) **Excess morbidity (episodes) due to respiratory infection**

Sub-optimal breastfeeding accounts for nearly 200,000 (197,925) episodes of URI and > 30,000 (33,495) episodes of LRI per year.

**C. Morbidity reductions with improvements in breastfeeding**

The hypothesized reductions in morbidity from diarrhea and respiratory infections from programs to improve breastfeeding practices can be approximated using the RR and attributable risk formulas. This is done by changing the percentages of infants following different breastfeeding practices at different ages, and taking the difference between the two excess morbidity estimates.

It must be stressed, however, that the numbers generated from these calculations can only be used to estimate the relative magnitude of the effect of breastfeeding improvement programs. The numbers should not be used as predictions, targets, or evaluation figures. This is because the estimates do not take into account the effects of conditions associated with both breastfeeding and infection susceptibility that may not be addressed in the breastfeeding intervention program, and it assumes that changes in feeding

patterns will have a fixed, additive effect on morbidity. Reductions in morbidity that might subsequently result from improvements in nutritional status, for example, are not considered in this exercise.

Following this procedure, if the prevalence of exclusive breastfeeding in infants < 6 months is increased by 30 percentage points to 45% (the mid-point of the medium prevalence category) and the prevalence of partial breastfeeding during this period is reduced by 30 percentage points to 42% then this could result in the following reductions in diarrheal and respiratory morbidity:

- > 30,000 (33,018) episodes of diarrhea.
- > 20,000 (24,890) episodes of URI.
- > 6,000 (6,422) episodes of LRI.

On the other hand, if all children were breastfed for at least one year and exclusive breastfeeding was unchanged, then the following reductions in diarrheal and respiratory morbidity could be expected:

- > 100,000 (111,762) episodes of diarrhea.
- > 90,000 (93,136) episodes of URI.
- > 10,000 (11,273) episodes of LRI.

If programs were effective at achieving 45% exclusive breastfeeding and all children were breastfed for at least one year, then the estimated reductions in diarrheal and respiratory morbidity would be:

- > 130,000 (136,891) episodes of diarrhea.
- > 120,000 (128,104) episodes of URI.
- > 17,000 (17,465) episodes of LRI.

**D. Excess Mortality - Diarrhea**

The excess diarrheal mortality due to sub-optimal feeding practices is calculated using the above data, the relative risks shown in Table 5, and the formulas outlined in Section I.

1) **Relative risk for sub-optimally breastfed infants**

$[\{0.843*(3.00) + 0.157*(18.0)\}*0.533] + \{(3.00)*0.467\} =$ **4.26**

Thus, sub-optimally breastfed infants are 4.3 times more likely to die from diarrhea than optimally breastfed infants in this population.

2) **Risk attributable to sub-optimal breastfeeding**

$\{0.583*(4.26-1)\} / \{0.583*(4.26-1)\}+1 =$ **0.6552**

Thus, 66% of all infant diarrhea deaths may be attributed to sub-optimal feeding practices.

3) **Excess mortality due to diarrhea**

Sub-optimal breastfeeding accounts for > 850 infant deaths per year (6,852 deaths * 0.19 due to diarrhea * 0.66 due to sub-optimal breastfeeding=859), or 12.5% of all infant deaths (859/6852).

### E. Excess Mortality - Respiratory Infections

The excess respiratory infection mortality (LRI) due to sub-optimal feeding practices is shown below:

1) **Relative risk for sub-optimally breastfed infants**

$[\{0.843*(2.00) + 0.157*(2.50)\}*0.533] + \{(1.50)*0.467\} =$ **1.81**

Thus, sub-optimally breastfed infants are 1.8 times more likely to die from lower respiratory infections than optimally breastfed infants in this population.

2) **Risk attributable to sub-optimal breastfeeding**

$\{0.583*(1.81-1)\} / \{0.583*(1.81-1)\}+1 =$ **0.3208**

Thus, 32% of all infant respiratory deaths may be attributed to sub-optimal feeding practices.

3) **Excess mortality due to respiratory infections**

Sub-optimal breastfeeding accounts for > 350 infant deaths per year due to respiratory infections (6,852*0.16*0.32=351), or 5.1% of all infant deaths.

Thus, approximately 18% of all infant deaths in El Salvador result from increased diarrhea (12.5%) and LRI (5.1%) that may be attributable to sub-optimal breastfeeding practices.

### F. Reductions in Mortality with Improvements in Breastfeeding

The hypothesized reductions in mortality from diarrhea and respiratory infections from programs to improve breastfeeding practices are approximated in the same way that the estimated morbidity reductions were calculated. As noted previously, this is done by changing the percentages of infants following different breastfeeding practices at different ages, and taking the difference between the two excess mortality estimates.

Using the same scenarios, if the prevalence of exclusive breastfeeding in infants < 6 months is increased by 30 percentage points to 45% (the mid-point of the medium prevalence category) and the prevalence of partial breastfeeding during this period is reduced by 30 percentage points to 42% then this could result in the following reductions in diarrheal and respiratory mortality:

- > 90 fewer deaths due to diarrhea (approximately a 10% reduction).
- > 70 fewer deaths due to LRI (approximately a 20% reduction).

On the other hand, if all children were breastfed for at least one year and exclusive breastfeeding was unchanged, then the following reductions in diarrheal and respiratory mortality could be expected:

- > 200 fewer deaths due to diarrhea (approximately a 25% reduction).

- > 130 fewer deaths due to LRI (approximately a 35% reduction).

If programs were effective at achieving 45% exclusive breastfeeding and all children breastfeeding for at least one year, then the estimated reductions in diarrheal and respiratory mortality are:

- > 300 fewer deaths due to diarrhea (approximately a 35% reduction).

- > 190 fewer deaths due to LRI (approximately a 55% reduction).

## IV. Recommended Changes to the Workbook

### A. Use prevalence of partial breastfeeding and complete weaning to calculate the multipliers.

As noted in Section I, the multipliers presented in the workbook are based on the assumption that the prevalence of complete weaning varies inversely and consistently with exclusive breastfeeding. The validity of this assumption is questionable, and overestimation of the percentage of infants no longer breastfeeding introduces a potentially high source of error in the workbook computations.

Most countries with data on the prevalence of exclusive breastfeeding also have information on the percent of children no longer breastfed and the percent who are partially breastfed at different ages. It is therefore recommended that the workbook be revised so that multipliers take into account varying prevalences of complete weaning during infancy for countries of high, medium, and low exclusive breastfeeding.

This can be done in several ways, depending on available data and the intentions of the users. The first way is to present a selection of breastfeeding options and multipliers for users, based on the joint prevalences of exclusive breastfeeding, partial breastfeeding, and no breastfeeding (complete weaning) at different ages. For example, multipliers can be estimated using the same methods and formulas but with options for high, medium, and low weaning rates for each exclusive breastfeeding category. In the simplest modification, users would be asked to select one multiplier from nine different feeding pattern options.

Alternatively, if data are available and users are mathematically inclined, then the actual formulas can be used to calculate country specific estimates, as was done using the data from El Salvador in Section III. The exact formulas and methods for determining different population-specific estimates (*i.e.*, % population sub-optimally breastfed, % of non-exclusively breastfed who are partially breastfed, etc.) should be given in an Appendix to walk the users through the process. Although the computations required in this section of the workbook are relatively simple, it is easy to get confused about the different numbers required at each step of the process, and precise instructions are essential.

### B. Modify the formulas to reflect differences in the distribution of infants 0-5 and 6-11 months

This is an extremely minor point that should be taken into consideration *only* if there is an accepted standard breakdown in this distribution (as used by demographers) or if the formulas are used to calculate excess morbidity and mortality estimates (as described above).

### C. Distinguish between lower and upper respiratory infections

The workbook should instruct users to calculate separately the excess LRI and URI morbidity associated with sub-optimal breastfeeding. This is because the protective effects of exclusive breastfeeding in early infancy and partial breastfeeding in later infancy are greater for LRI than for URI. URI is far more common than LRI, and sub-optimal breastfeeding will be associated with more episodes of URI than LRI. As noted by Mora (1991), infants do not usually die from URI. Therefore, excess mortality calculations should be based on LRI mortality risks and episodes.

### D. Use of excess episodes versus excess days of illness

As noted previously, the workbook estimates the number of excess episodes of illness attributable to sub-optimal breastfeeding, but the risk estimates used to calculate the morbidity multipliers are based on prevalence rate ratios (indicating excess days) instead of incidence rate ratios (indicating excess episodes). The formulas and risk estimates used in this report have been corrected to reflect differences in illness incidence by feeding category. All of the morbidity calculations in Section IV are presented in terms of illness episodes.

If the workbook maintains its focus on excess illness episodes, then multipliers have to be recalculated using the RRs presented in Tables 1 and 2. For all ARI, use of the relative risk or incidence estimates requires acceptance of the assumption that durations of illness vary among feeding groups as indicated on page 6, based on observed differences in diarrhea duration. These assumptions produce reasonable results when compared to findings from other studies (see previous sections).

Alternatively, the workbook could shift its emphasis from excess episodes of illness to excess days of illness attributable to sub-optimal feeding. The advantages of this approach are 1) it produces larger, more impressive numbers to influence policymakers, 2) risk estimates are available from the Peruvian data, and 3) days of illness can be directly multiplied by other economic costs per day (lost daily wages or productivity, for example).

The disadvantages of this approach are: 1) it assumes all days of illness are equally important (yet, with URI, for example, symptoms such as cough are included in the diagnosis definition but may have little effect on the infant or family), 2) it may be difficult to calculate days of illness per infant per year from existing data, and 3) estimations on anticipated reductions in morbidity with improved breastfeeding practices are complex and complicated by the numerous individual characteristics that influence illness duration and severity. For example, sub-optimal breastfeeding increases the risk of diarrhea (incidence) primarily through increasing an infant's exposure to diarrhea-producing pathogens. The duration of diarrhea is influenced by many additional factors that are both directly and indirectly influenced by feeding mode (such as prior nutritional status, continued feeding, types of foods given, pathogen involved, etc.).

Therefore, from an epidemiologic point of view, dealing with excess episodes of illness is more satisfactory than excess days, given the nature of the problem, the assumptions required, and the data available for these calculations. From an advocacy point of view, however, use of excess days may be more compelling to inspire policy actions. Therefore, calculations of excess days of diarrhea and respiratory morbidity that may result from sub-optimal breastfeeding practices are given in Appendix B.

### D. Use of PROFILES

The PROFILES computing system was developed by the Nutrition Communications Project of the USAID's Office of Nutrition. The purpose of this system is to provide tools for nutrition advocacy, by illustrating (graphically) the economic and health impacts of undernutrition, and the potential benefits

of programs to improve feeding practices and nutritional status. The statistical models that form the basis of this system were constructed from available epidemiologic data, including the studies cited in this report. The most recent PROFILES system (2.0) is interactive (meaning users can manipulate variables in the models to reflect different nutrition conditions and program options) and many of the costs addressed in the workbook can be graphically displayed using the PROFILES software (to create slides, overheads, or a computer-driven presentation).

Consideration should be given to combining the workbook and its resulting reports with a PROFILES presentation, if advocacy about breastfeeding interventions is going to be seriously undertaken in El Salvador or in other locations. PROFILES' models and abilities should be explored in order to determine how the workbook and the software can be coherently combined to influence policy decisions.

### E. Population at risk

Consideration should be given to basing calculations of excess morbidity and mortality on the population that is at-risk of increased infection rather than the entire infant population. Identifying the at-risk population is somewhat difficult given that the protective effect of breastfeeding has been observed in developed as well as disadvantaged populations. Given, however, that the relative risks were derived from low-income populations and that risk is likely to vary between income groups, this would be a conservative response if there is criticism that the workbook overestimates excess morbidity.

### F. Morbidity episodes

Data on diarrhea and respiratory infection incidence and prevalence are not available for all countries. To allow approximations to be made for countries without this data, the workbook could include alternatives based on worldwide data, as described previously in this report.

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**Table 1.** The relationship between diarrheal morbidity and feeding practices in Huascar, Peru

| **0-5 months** | **# observation days** | **# days ill** | **# episodes** |
|---|---|---|---|
| Exclusive breastfeeding | 1276 | 90 | 23 |
| Partial | 22038 | 3355 | 557 |
| No breastfeeding | 1138 | 314 | 53 |
| | **Relative risk** | **Prevalence rate ratio** | **Odds ratio** |
| Exclusive breastfeeding | 1.00 | 1.00 | 1.00 |
| Partial | 1.41 | 2.16 | 2.37 |
| No breastfeeding | 2.59 | 3.91 | 5.02 |

| **6-11 months** | **# observation days** | **# days ill** | **# episodes** |
|---|---|---|---|
| Exclusive breastfeeding | 0 | 0 | 0 |
| Partial | 19604 | 2878 | 535 |
| No breastfeeding | 2424 | 572 | 86 |
| | **Relative risk** | **Prevalence rate ratio** | **Odds ratio** |
| Partial | 1.00 | 1.00 | 1.00 |
| No breastfeeding | 1.30 | 1.61 | 1.80 |

Notes:

Relative risk is the ratio of two incidence rates, with the denominator being the reference category.

Prevalence rate ratio is the ratio of two prevalence rates, with the denominator being the reference category.

Odds ratio is determined from the number of days ill and not ill for each feeding category.

**Table 2.** The relationship between upper (URI) and lower (LRI) respiratory infection and feeding practices in Huascar, Peru

| | | URI | LRI |
|---|---|---|---|
| **0-5 months** | **# observation days** | **# days ill** | **# days ill** |
| Exclusive breastfeeding | 1276 | 37 | 2 |
| Partial | 22038 | 1376 | 150 |
| No breastfeeding | 1138 | 136 | 10 |

| | Relative risk (estimated)[1] | Odds ratio | Relative risk (estimated) | Odds ratio |
|---|---|---|---|---|
| Exclusive breastfeeding | 1.00 | 1.00 | 1.00 | 1.00 |
| Partial | 1.40 | 2.23 | 2.82 | 4.37 |
| No breastfeeding | 2.68 | 4.55 | 3.64 | 5.65 |

| | Prevalence rate ratio | Prevalence rate ratio |
|---|---|---|
| Exclusive breastfeeding | 1.00 | 1.00 |
| Partial | 2.16 | 4.34 |
| No breastfeeding | 4.12 | 5.61 |

[1] Estimated assuming the exclusively breastfed infants < 6 months have episodes of URI and LRI that are 65% shorter (average: 9.1 days) than all other infants (average: 14 days). See text for explanation.

| | | URI | LRI |
|---|---|---|---|
| **6-11 months** | **# observation days** | **# days ill** | **# days ill** |
| Exclusive breastfeeding | 0 | 0 | 0 |
| Partial | 19604 | 2457 | 180 |
| No breastfeeding | 2424 | 362 | 43 |

| | Relative risk (estimated)[2] | Odds ratio | Relative Risk (estimated) | Odds Ratio |
|---|---|---|---|---|
| Partial | 1.00 | 1.00 | 1.00 | 1.00 |
| No breastfeeding | 1.00 | 1.23 | 1.55 | 1.95 |

| | Prevalence rate ratio | Prevalence rate ratio |
|---|---|---|
| Partial | 1.00 | 1.00 |
| No breastfeeding | 1.19 | 1.93 |

2 Assumes that the average duration of URI and LRI is 14 days for weaned infants and 11.2 days for partially breastfed infants. See text for explanation. Note that there is no increased risk of URI incidence for weaned infants compared to partially breastfed infants when this assumption is applied.

**Table 3.** Comparison of relative risks of diarrhea by infant feeding practices in longitudinal studies conducted in Peru, Bangladesh, Philippines, and Brazil.

| | Peru | Bangladesh[1] | Philippines[2] | Brazil[3] |
|---|---|---|---|---|
| # Infants | 150 | 130 (est) | > 3000 | 548 |
| **0-5 months** | | | | (3 months) |
| Exclusive | 1.00 | 1.00 | | 1.00 |
| Partial | 1.41 | 1.08 | | 1.65 |
| None | 2.59 | N/A | | 4.22 |
| **6-11 months** | | | | |
| Exclusive | --- | | ---- | |
| Partial | 1.00 | | 1.00 | |
| None | 1.30 | | 1.32 | |

[1]Data obtained from Raqui, AH. Epidemiology of persistent diarrhea in Bangladesh children. Doctoral dissertation submitted to the School of Hygiene and Public Health, Johns Hopkins University. Baltimore, MD, 199C.

[2]These are adjusted relative risks obtained from data in Popkin BM, Adair L, Akin JS, *et al.* Breastfeeding and diarrheal morbidity. *Pediatrics* 1990; 86(6): 874-882.

[3]Relative risks adjusted for income and weight at birth. Data taken from Martines JC. The interrelationships between feeding mode, malnutrition, and diarrhoeal morbidity in early infancy among the urban poor in southeastern Brazil. Doctoral thesis submitted to the Faculty of Medicine. University of London, 1988.

**Table 4.** Relative risk of mortality due to diarrhea and ARI by infant feeding practices and age in southern Brazil[1]

| Feeding mode | **Diarrhea** | | **Respiratory infection** | |
|---|---|---|---|---|
| Breast only | 1.0 | | 1.0 | |
| Breast + milk | 5.7 | (3.7)[2] | 1.7 | (2.3) |
| Breast + non-milk | 2.6 | (1.9) | 0.2 | (0.3) |
| Breast + milk + non-milk | 3.7 | (3.6) | 0.3 | (0.2) |
| Milk only | 18.3 | (14.7) | 2.9 | (3.0) |
| Milk + non-milk | 15.6 | (6.5) | 1.2 | (1.1) |

| Age in months: | **0-1.9** | **2-11.9** | **0-1.9** | **2-11.9** |
|---|---|---|---|---|
| Breast only | 1.0 | 1.0 | 1.0 | 1.0 |
| Breast + other milk | 3.3[3] | 2.2 | 2.3 | 1.3 |
| No breast | 23.3 | 5.3 | 4.1 | 3.4 |

1 From Victora *et al.* (1987)

2 RR in parentheses are adjusted for age. All other RR are adjusted for age and other confounding variables.

3 RR in this table are adjusted for confounding variables noted in text.

**Table 5.** Relative risk estimates used to calculate mortality multipliers[1]

| Feeding mode | **Diarrhea** | | **Respiratory infection** | |
|---|---|---|---|---|
| Age in months | **0-5.9** | **6-11.9** | **0-5.9** | **6-11.9** |
| Exclusive breastfeeding | 1.0 | 1.0 | 1.0 | 1.0 |
| Partial | 3.0 | 1.0 | 2.0 | 1.0 |
| No breastfeeding | 18.0 | 3.0 | 2.5 | 1.5 |

Adapted from Victora *et al.* (1987) using methods discussed in Huffman *et al.* (1991).

## Appendix A

## ESTIMATING ANNUAL RATE FROM 2-WEEK INCIDENCE AND VICE-VERSA, ACCOUNTING FOR SEASONAL VARIATIONS IN DIARRHOEA (adapted from WHO, 1992)

From the survey you can estimate the 2-week diarrhoea prevalence rate, which can be converted to a 2-week incidence rate as just described. However, for reporting and programme planning (e.g., projection of ORS needs), it is more useful to have an estimate of the number of episodes of diarrhoea per child per year.

To estimate the annual incidence (per child) of diarrhoea, it may not be appropriate to multiply the 2-week incidence rate by 26, as this would not take into account seasonal variations in diarrhoea incidence. To account for seasonal variations, use the following formula:

Annual incidence = 2-week diarrhoea incidence rate ÷ Proportion of annual diarrhoea episodes expected to have occurred during 2-week recall period of survey

2-week diarrhoea prevalence means the number of episodes of diarrhoea occurring (i.e., starting <u>or</u> continuing) during a 2-week period. 2-week incidence means the number of episodes <u>starting</u> during a 2-week period.

In the survey questionnaire caretakers are asked if their children have had diarrhoea in the past 2-weeks. The answer to this question should give you 2-week prevalence.

The 2 week prevalence rate can be converted to a 2-week incidence rate as described below.

$$\text{2-week diarrhoea incidence rate} = \text{2-week diarrhoea prevalence rate} \times \frac{14}{14 + \text{average duration of a diarrhoea episode}}$$

This formula can be expressed in a shorter way using letters to represent the different parts of the equation. (The subscript 14 refers to 2 weeks, i.e., 14 days.)

$$I_{14} = P_{14} \times \frac{14}{14 \div d}$$

Since you know $P_{14}$ from the survey, all you need to solve the equation is "d", the average duration of a diarrhoea episode.

The usual duration of a diarrhoeal episode is 5 days with a range from 3 - 7 days. You can make an estimate within this range and use it to solve the formula.

## Appendix B

### Excess Morbidity Days - Diarrhea

The excess days with diarrhea that may be attributed to sub-optimal breastfeeding practices, using prevalence rate ratios in place of relative risk estimates, are:

1) **Increased risk (days) for sub-optimally breastfed infants**

$[\{0.843*(2.16) + 0.157*(3.91)\}*0.533 + \{(1.61)*0.467\} =$ **2.05**

Thus, sub-optimally breastfed infants suffer 2 times as many days with diarrhea than optimally breastfed infants.

2) **Excess days attributable to sub-optimal breastfeeding**

$\{0.583*(2.05-1)\} / \{0.583*(2.05-1)\}+1 =$ **0.3797**

Thus, 38% of all infant diarrhea days may be attributed to sub-optimal feeding practices. This is equivalent to 11 days per infant per year (29*0.38).

3) **Excess morbidity (days) due to diarrhea**

Sub-optimal breastfeeding may account for > 1,600,000 days of diarrhea per year in El Salvador (11*152,250=1,674,750).

Note, as above, that this figure is based on the assumption that all infants are at risk of diarrhea because of sub-optimal breastfeeding practices. The estimate is also likely to be too high because it is based on an average duration of 5 days for all infants. If days of illness are used, estimates should be corrected for assumed differences in illness duration for infants following different feeding practices.

### Excess Morbidity Days - Respiratory Infections

1) **Increased risk (days) for sub-optimally breastfed infants**

$[\{0.843*(2.16) + 0.157*(4.12)\}*0.533 + \{(1.19)*0.467\} =$ **1.87 for URI**

$[\{0.843*(4.34) + 0.157*(5.61)\}*0.533 + \{(1.93)*0.467\} =$ **3.32 for LRI**

Thus, sub-optimally breastfed infants spend 1.9 times as many days with URI and 3.3 times as many days with LRI than optimally breastfed infants.

2) **Excess days attributable to sub-optimal breastfeeding**

$\{0.583*(1.87-1)\} / \{0.583*(1.87-1)\}+1 =$ **0.3365 for URI**

$\{0.583*(3.32-1)\} / \{0.583*(3.32-1)\}+1 =$ **0.5749 for LRI**

Thus, 34% of all infant URI days and 57% of all LRI days may be attributed to sub-optimal feeding practices.

This is equivalent to 40 days of URI and 4 days of LRI per infant per year.

3) **Excess morbidity (days) due to respiratory infection**

Sub-optimal breastfeeding accounts for > 6.0 million days of URI (6,090,000) and > 600,000 days of LRI (609,000) per year in El Salvador.

Note, as above, that this figure is based on the assumption that all infants are at risk of ARI because of sub-optimal breastfeeding practices. The estimate is also likely to be too high because it is based on an average duration of 14 days for all infants. If days of illness are used, estimates should be corrected for assumed differences in illness duration for infants following different feeding practices.

# ANNEX 2

## Methodology Used to Calculate Births Averted Attributable to Breastfeeding Practices

The Futures Group has prepared a computer program to calculate changes in fertility (as measured by total fertility rates) based on different levels of contraception, types of contraceptive mix, and changes in the proximate determinants of fertility, including duration of postpartum insusceptibility[1]. The equations used to determine Total Fertility Rate (TFR) are shown below and based on Bongaarts and Potter, 1983.[2]

**(1) Total fertility rate**

$$TFR = Cm \times Cc \times Ci \times Ca \times Cs \times TF$$

where:

| | | |
|---|---|---|
| TFR | = | the total fertility rate |
| Cm | = | the proportion of women 15-49 in union |
| Cc | = | the index of contraception |
| Ci | = | the index of postpartum infecundability |
| Ca | = | the index of induced abortion |
| Cs | = | the index of sterility |
| TF | = | total fecundity |

**(2) Index of contraception**

The index for contraception is calculated as a function of the proportion of women using contraception and the effectiveness of the contraceptive methods.

$$Cc = 1 - 1.08 \times u \times e$$

where:

| | | |
|---|---|---|
| u | = | the contraceptive prevalence rate |
| e | = | the average effectiveness of contraception |

The average effectiveness is the weighted average of the effectiveness of each method and the proportion of users using that method.

$$e_{\text{All methods}} = \Sigma\, e_m \times \text{Method Mix}_m$$

where:

Method Mix (m) = the proportion of all users using method m

[1] Stover, J., J.C. Knowles, A.E. Wagman and D.L. Nortman (1993). Target-Costs: A Model for Projecting the Family Planning Service Requirements and Costs to Achieve Demographic Goals. Methodology and manual prepared by the Futures Group funded by the U.S. Agency for International Development under the OPTIONS II Project, Glastonbury, CN.

[2] Bongaarts, J. and R.G. Potter (1983). Fertility, Biology, and Behavior: An Analysis of the Proximate Determinants. New York: Academic Press.

### (3) Index of postpartum infecundability

The index of postpartum infecundability is calculated as the ratio of the average birth interval with and without breastfeeding.

$$Ci = 20 \div (18.5 + i)$$

where:

i = the average duration (in months) of infecundability from birth to the first postpartum ovulation or resumption of intercourse (measured by the period of postpartum amenorrhea or abstinence)

### (4) Index of induced abortion

The index of induced abortion is calculated as a function of the total abortion rate, the total fertility rate and the contraceptive prevalence rate.

$$Ca = TFR \div [TFR + 0.4 \times (1 + u) \times TA]$$

where:

TA = the total abortion rate (the average number of induced abortions a woman would have at the end of her reproductive period if she had abortions at the prevailing age-specific rates)

### (5) Index of sterility

The index of sterility is calculated from the percentage of women in union who remain childless at the end of the reproductive years.

$$Cs = (7.63 - .11 * s) \div 7.3$$

where:

S = the percent of women in union who remain childless at the end of the reproductive years

Using data from the 1993 Family Health Survey (FESAL), we know the current TFR (3.85), current contraceptive prevalence (53.3%), the contraceptive mix, as well as the duration of postpartum infecundability (7.5). We used the Target program to estimate the TFR for El Salvador under two new conditions: a) decreasing the duration of postpartum infecundability to 1.5 months (the average if all women were not breastfeeding), and b) increasing the duration of postpartum infecundability by 25% from the current level of 7.5 months to 9.4 months. This increase in postpartum infecundability is estimated based on a conservative but nevertheless arbitrary assumption that doubling the prevalence of exclusive breastfeeding among infants $\leq$ 6 months and increasing the prevalence of partial breastfeeding among infants > 6 months would result in a 25% increase in the prevalence of amenorrhea and associated postpartum infecundability among mothers of infants 0-12 months.

We use the ratio of the current TFR to the predicted TFR and the current number of births observed to estimate the a) expected births assuming no breastfeeding, and b) expected births assuming a greater duration of postpartum infecundability. The difference between the expected births and current births provides the estimated number of births averted for each scenario.

The number of expected births B under scenario 0 (no breastfeeding) and scenario 2 (higher than current) can be obtained as:

$$B_o = B_1 \times (TFR_0 / TFR_1)$$

$$B_2 = B_1 \times (TFR_2 / TFR_1)$$

where $B_1$ is the current number of births.

Averted births AB are obtained from the differences of number of births:

$$AB_o = B_o - B_1$$

$$AB_2 = B_o - B_2$$

And the additional number of births averted from the (current) scenario 1 to scenario 2 (higher) are:

$$AB_{1\text{-}2} = B_2 - B_1$$

The data used to make these calculations are given in Table 1. In addition to using the Target program to make these calculations, we have illustrated how they can be performed using simple mathematical calculations shown in the attached spreadsheet using the El Salvador data (NURT3.WK1).

**Table 1**
**Data for Calculation of Births Averted by Breastfeeding in El Salvador**

| DATA | LEVEL | | SOURCE |
|---|---|---|---|
| Postpartum Infecundability | 7.5 mo. | | FESAL, 1993 |
| Induced Abortion | 0% | | TARGET, 1994 |
| Sterility | .2% | | TARGET, 1994 |
| TFR (1993) | 3.85 | | FESAL, 1993 |
| Contraceptive Use Rate | 53.3% | | FESAL, 1993 |
| Contraceptive Mix | % Using | Effectiveness Rate | FESAL,1993/ (% using) TARGET, 1994 (effect. rate) |
| Female Sterilization | 59.0% | 100% | |
| Oral Contraceptives | 16.3% | 94% | |
| Condoms | 3.9% | 83% | |
| IUD | 3.9% | 97% | |
| Injections | 6.7% | 98% | |
| Rhythm | 5.6% | 83% | |
| Withdrawal | 3.7% | 83% | |
| Male Sterilization | .9% | 100% | |
| Combined Contraceptive Effectiveness | 96.5% | | |
| Percent of women of reproductive age married or in union | 64.0% | | FESAL, 1993 |

C.1 Births Averted

EQUATION

TFR= Cm * Cc * Cppi * Ca * Cs * TF

1) Cm=Proportion Married

2) Cc= 1 - 1.08 (u*e) (u = Contraceptive prevalence rate; e=Aggregate Effectivenss)

3) Cppi=20/(18.5+ppi)

4) Ca=TFR/(TFR+.4*(1+u)*TA (TA=abortion rate, u=contraceptive prevalence rate)

5) Cs=(7.63-.11*s)/7.3 (s=% sterile). We modify this formula to simplify the equation:

Cs = 1 - s

DATA NEEDED

1) Proportion Married 0.64

2) Contraceptive use and effectiveness

| | Proportion of women using contra. | | Proportion of contraceptors using each method (Formula) | (Value) | Use Effectiv | Aggregate Effectiveness (Form | (Value) | |
|---|---|---|---|---|---|---|---|---|
| Column A | B | | C | D | E | F | | |
| Users Fem sterilization | 0.314 | +++ | .314/0.533 | 0.589 | 1 | E*D | 0.589 | A3 |
| Users Oral | 0.087 | | .087/0.533 | 0.163 | 0.94 | E*D | 0.153 | A4 |
| Users Condoms | 0.021 | | .021/0.533 | 0.039 | 0.83 | E*D | 0.032 | A5 |
| Users IUD | 0.021 | | .021/0.533 | 0.039 | 0.97 | E*D | 0.038 | A6 |
| Users Injections | 0.036 | | .036/0.533 | 0.068 | 0.98 | E*D | 0.067 | A7 |
| Users Rhythm | 0.03 | | .03/0.533 | 0.056 | 0.83 | E*D | 0.046 | A8 |
| Users Withdrawal | 0.02 | | .02/0.533 | 0.038 | 0.83 | E*D | 0.032 | A9 |
| Users Male sterilization | 0.004 | | .004/0.533 | 0.008 | 1 | E*D | 0.008 | A10 |
| a) Contraceptive prevalence rate | 0.533 | (u) | | | | | | |
| Non-users | 0.467 | | | | | | | |
| Total | 1 | | | 1 | | | | |
| b) Aggregate use-effectiveness | | | Weighted a (e) | | | SUM (E*D) | 0.965 | |

3) Postpartum infecundability (ppi)

| | | |
|---|---|---|
| Months of pp infecund. w/out b-feed | 1.5 mo. | 1.5 |
| Months of pp infecund. with current bf | 7.5 mo. | 7.5 |
| Months of pp infecund. with alternative 25% inc. in duration of ppi | 1.25*7.5=9.4 mo. | 9.4 |

4) Abortion rate= 0

5) Sterility rate = .02

6) Current TFR=3.85

+++ Varies slightly (.314 vs. .315 reported in FESAL, 1993)

CALCULATIONS

First solve for TF (total fecundity in absence of contraception or breastfeeding)

TFR = Cm * Cc * Cppi * Ca * Cs * TF

Current Level of Breastfeeding

3.85=.64 * (1-1.08(.533*.965) * (20/18.5+7.5) * 3.85/(3.85+0) * 1-(.02)* TF

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3.85 | = | 0.64 | 0.445 | 0.769 | 1 | 0.98 TF |
| | 3.85 | = | 0.21463098 TF | | | | |
| TF | | = | 17.94 | | | | |

Projected with No BF

TFR=.64 * (1-1.08(.533*.965) * (20/18.5+1.5) * 3.85/(3.85+0) * 1-(.02) * TF

| | | | | | | |
|---|---|---|---|---|---|---|
| TFR | 0.64 | 0.445 | 1 | 1 | 0.98 | 17.94 |
| TFR | = | 5.01 | | | | |

Projected with Increased Breastfeeding and PPI

TFR = .64 * (1-1.08(.533*.965) * (20/18.5+9.4) * 3.85/(3.85+0) * 1-(.02)

| | | | | | | |
|---|---|---|---|---|---|---|
| TFR = | 0.64 | 0.4445 | 0.717 | 1 | 0.98 | 17.94 |
| TFR | = | 3.59 | | | | |

| | | Current births |
|---|---|---|
| TFR w/out b-feed | 5.01 | 151200 |
| TFR with current bf | 3.85 | 151200 |
| TFR with alternative bf | 3.59 | 151200 |

| | | | | Ratio |
|---|---|---|---|---|
| Current number of births | 151200 | | | |
| Births without b-feed | 151200 | 5.01/3.85 | 196756 | 1.3012987 |
| Births with alternative | 151200 | 3.59/3.85 | 140989 | 0.93246753 |

| | | | | % births averted |
|---|---|---|---|---|
| Current births averted | 196756 | 151200 | 45556 | 30.13 |
| Alternative births averted (diff) | 196756 | 140989 | 55767 | 36.88 |

# WELLSTART INTERNATIONAL

Wellstart International is a private, nonprofit organization dedicated to the promotion of healthy families through the global promotion of breastfeeding. With a tradition of building on existing resources, Wellstart works cooperatively with individuals, institutions, and governments to expand and support the expertise necessary for establishing and sustaining optimal infant feeding practices worldwide.

Wellstart has been involved in numerous global breastfeeding initiatives including the Innocenti Declaration, the World Summit for Children, and the Baby Friendly Hospital Initiative. Programs are carried out both internationally and within the United States.

**International Programs**

Wellstart's *Lactation Management Education (LME) Program*, funded through USAID/Office of Nutrition, provides comprehensive education, with ongoing material and field support services, to multidisciplinary teams of leading health professionals. With Wellstart's assistance, an extensive network of Associates from more than 40 countries is in turn providing training and support within their own institutions and regions, as well as developing appropriate in-country model teaching, service, and resource centers.

Wellstart's *Expanded Promotion of Breastfeeding (EPB) Program*, funded through USAID/Office of Health, broadens the scope of global breastfeeding promotion by working to overcome barriers to breastfeeding at all levels (policy, institutional, community, and individual). Efforts include assistance with national assessments, policy development, social marketing including the development and testing of communication strategies and materials, and community outreach including primary care training and support group development. Additionally, program-supported research expands biomedical, social, and programmatic knowledge about breastfeeding.

**National Programs**

Nineteen multidisciplinary teams from across the U.S. have participated in Wellstart's lactation management education programs designed specifically for the needs of domestic participants. In collaboration with universities across the country, Wellstart has developed and field-tested a comprehensive guide for the integration of lactation management education into schools of medicine, nursing and nutrition. With funding through the MCH Bureau of the U.S. Department of Health and Human Services, the NIH, and other agencies, Wellstart also provides workshops, conferences and consultation on programmatic, policy and clinical issues for healthcare professionals from a variety of settings, e.g. Public Health, WIC, Native American. At the San Diego facility, activities also include clinical and educational services for local families.

*Wellstart International is a designated World Health Organization Collaborating Center on Breastfeeding Promotion and Protection, with Particular Emphasis on Lactation Management Education.*

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