The Economic Benefits of Breastfeeding: A Review and Analysis. By Jon Weimer. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Food Assistance and Nutrition Research Report No. 13.

Abstract

A minimum of $3.6 billion would be saved if breastfeeding were increased from current levels (64 percent in-hospital, 29 percent at 6 months) to those recommended by the U.S. Surgeon General (75 and 50 percent). This figure is likely an underestimation of the total savings because it represents cost savings from the treatment of only three childhood illnesses: otitis media, gastroenteritis, and necrotizing enterocolitis. This report reviews breastfeeding trends and previous studies that assessed the economic benefits of breastfeeding.

Keywords: Breastfeeding, economic benefits, otitis media, gastroenteritis, necrotizing enterocolitis.

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Summary

Successfully promoting and supporting breastfeeding in the United States may depend on persuading both mothers and society that breastfeeding is not only nutritionally sound but economically beneficial as well. Current U.S. rates of breastfeeding are 64 percent for mothers in-hospital and 29 percent at 6 months postpartum, below the recommendations of the Surgeon General (75 and 50 percent, respectively). This analysis concludes that a minimum of $3.6 billion would be saved if the prevalence of exclusive breastfeeding increased from current rates to those recommended by the Surgeon General. These savings would result from reducing both direct costs (such as formula costs and physician, clinic, hospital, laboratory, and procedural fees) and indirect costs (such as time and wages lost by parents attending to an ill child).

The American Academy of Pediatrics (AAP) and the American Dietetic Association (ADA) endorse breastfeeding as the most beneficial method to ensure the health and well-being of most infants. The U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) has initiated a national program by Federal, State, and local WIC programs to promote breastfeeding to WIC mothers. This report delineates that a number of studies demonstrate that breastfeeding improves infants' general health and development and protects against a number of acute and chronic diseases.

A number of reasons are cited for why more mothers do not breastfeed: aggressive formula product marketing, lack of support from friends/family, insufficient knowledge among medical professionals, maternity hospital practices, cultural attitudes, and an increasing number of women in the work force.

This report reviews the few studies that have been conducted in the United States to assess the economic benefits of breastfeeding. Most earlier studies that addressed this issue looked at the economic effect of breastfeeding in the context of comparing breastfeeding with formula feeding, both within and outside the WIC program. These studies indicated that breastfeeding was economically advantageous and that the promotion of breastfeeding could be an effective cost-containment measure. By and large, these studies looked at the economic effect of breastfeeding at specific sites (State WIC clinic, local health maintenance organization (HMO), or health clinic) and from an individual perspective. The analysis reported in this study goes one step further in measuring the reduced costs to society as childhood illnesses and premature deaths are prevented.

This analysis uses incidence rates from published studies to estimate the reduction in the number of cases of otitis media, gastroenteritis, and necrotizing enterocolitis that could be expected for varying prevalences of breastfeeding. Cost data, both direct and indirect, were derived from published literature and extracted from U.S. Government sources. This analysis indicated that a minimum of $3.6 billion would be saved if the prevalence of exclusive breastfeeding increased from current rates to those recommended by the Surgeon General. This figure reflected approximately $3.1 billion attributable to preventing premature deaths (necrotizing enterocolitis), and an additional $0.5 billion in annual savings associated with reducing traditional medical expenditures (for example, doctors' or hospital visits, laboratory tests, among others) and indirect costs, such as lost earnings of parents.

The $3.1 billion figure probably underestimated the total savings likely because it reflected the savings in treating only three childhood illnesses. That figure also excluded the cost of purchases for over-the-counter medications for otitis media and gastroenteritis symptoms, physician charges for treatment of necrotizing enterocolitis, and savings due to reduced long-term morbidity. Although this study provided an analysis from a different perspective than previous studies, the results are consistent with those from prior investigations in demonstrating potentially substantial cost savings from breastfeeding.

Given that breastfeeding provides immunologic protection against a variety of childhood illnesses, health care providers, corporate administrators, and State and Federal policymakers may be able to reduce their programs' medical costs, over the long term, by promoting and supporting breastfeeding. However, further research on health and cost benefits from breastfeeding is needed, ideally, large-scale studies for an entire range of child-related illnesses focusing on differences in rates of hospitalization, duration of hospitalization, health service use, and medical costs between breastfed and formula-fed infants. Without such studies, employers, insurance companies, and Federal health-policy decisionmakers are unlikely to provide financial incentives either to encourage breastfeeding or to encourage health providers, such as physicians, to provide better support and care for breastfeeding mothers.

The Economic Benefits of Breastfeeding
A Review and Analysis

Jon P. Weimer

Introduction

Breastfeeding is widely believed to be the most beneficial method of feeding for the health and well-being of most infants.[1] And, although breastfeeding is not recommended for all mothers (such as those who use illegal drugs, receive cancer chemotherapy, or test HIV-positive), public health experts, such as the American Academy of Pediatrics (AAP), the American Dietetic Association (ADA), and the Surgeon General, endorse breastfeeding as the preferred infant-feeding method in most cases. More recently, the AAP issued a policy statement recommending that infants be breastfed throughout their first year of life (American Academy of Pediatrics, 1997).

The U.S. Surgeon General proposed to increase the proportion of mothers who breastfeed their babies in the early postpartum period to 75 percent nationally by 2000, and to increase the proportion who continue breastfeeding until their babies are 5 to 6 months old to at least 50 percent. According to the latest data from Abbott Laboratories (1998), about 64 percent of women giving birth in a hospital breastfeed, and approximately 29 percent still breastfeed at 6 months. Women in lower socioeconomic groups are less likely to breastfeed and to breastfeed for a shorter time than women in higher socioeconomic groups. Data from a 1996 national survey, for example, indicate that only 42 percent of women from households with incomes less than $10,000 breastfeed at all and only 12 percent breastfeed for 6 months (Abbott Laboratories, 1996).

Breastfeeding Trends

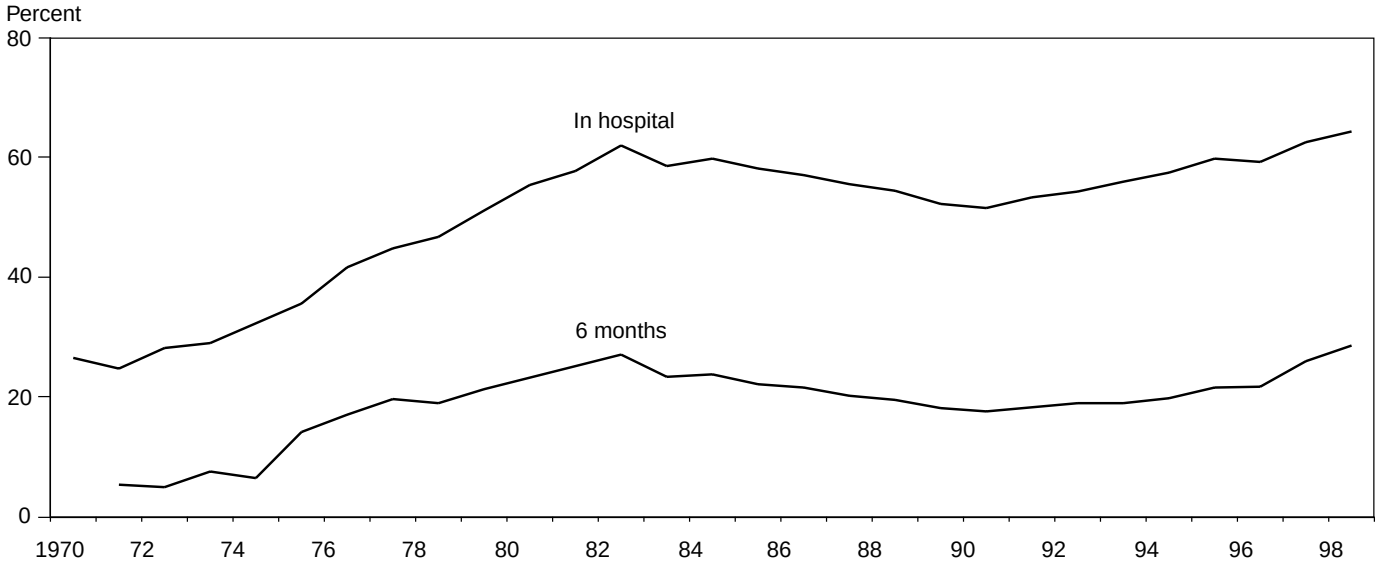
Almost all U.S. newborns were nursed up until around 1950. In the last 50 years, however, infant feeding has changed markedly. After World War II, with the development and large-scale manufacture of infant formula, formula feeding became the standard. Breastfeeding fell by half between 1946 and 1956, and by 1967, only 25 percent of American infants were being breastfed at the time of hospital discharge. The percentage of infants being breastfed when they left the hospital then began to increase steadily, reaching 62 percent in 1982, declined approximately 16 percent from 1982 to 1990, and increased slowly again to hover around 64 percent by 1998 (fig. 1). The prevalence of breastfeeding for 6-month-old infants paralleled that for newborns, although at a considerably lower level. In 1998, about 29 percent of 6-month-old infants were being breastfed.

Mothers may refrain from breastfeeding for a number of reasons: aggressive formula product marketing; lack of support from family and friends; insufficient knowledge among medical professionals about breastfeeding techniques and challenges; maternity hospital practices (short maternal stays, for example); religious beliefs; cultural attitudes; and lack of public acceptance (Losch et al., 1995; Weimer, 1999). All or some of these factors may come into play, but it is of interest that increased formula feeding parallels a rapid increase in the number of working women. Breastfeeding and working outside the home are commonly believed to be incompatible. A woman who works outside the home must have a place and time to nurse her baby or express and store her milk for bottle feeding. Increased participation of women in the labor force is frequently cited for the low rates of breastfeeding (Cohen et al., 1995).

The increase in the number of working women since World War II is one of the most significant social and economic trends in modern U.S. history. In the United States, the number of women in the labor force increased by 178 percent between 1950 and 1985, while the number of men in the work force increased by only 47 percent (U.S. Bureau of Labor Statistics, 1998). By 1997, 59 percent of women (16 years and

[1] Breastfeeding generally refers to a mother feeding an infant at her breast but may refer also to feeding breastmilk from a bottle.

Figure 1
Breastfeeding in the United States has rebounded from low rates in the 1970's



Note: The percentage of infants breastfed at 6 months was not measured in 1970.
Source: Ross Laboratories Mothers' Survey, Ross Products Division, Abbott Laboratories,1998

older) worked, compared with 28 percent in 1940. In 1995, 41 percent of the employed women had children under the age of 18, and 55 percent of this group had returned to the workplace before their children's first birthday (Hayghe, 1997). Many workplaces seem not to support breastfeeding or extraction of breastmilk in the workplace, inhibiting breastfeeding after women return to work.

Breastfeeding Health Advantages

In their endorsement of breastfeeding, entities such as the AAP and the ADA cite studies to support the view that breastfeeding improves infants' general health, growth, and development and protects against their developing a number of acute or chronic diseases. As reported in a 1997 policy statement issued by the AAP, research in the United States, Canada, Europe, and other developed countries suggests that breastfeeding decreases the incidence and/or severity of diarrhea (Dewey et al., 1995; Popkin et al., 1990), lower respiratory infection (Wright et al., 1989), otitis media (Duncan et al., 1993; Owen et al., 1993), bacterial meningitis (Cochi et al., 1986; Istre et al., 1985), botulism (Arnon, 1984), urinary tract infection (Pisacane, 1992), and necrotizing enterocolitis (Lucas and Cole, 1990). Other studies show that breastfeeding may protect against sudden infant death syndrome (Ford et al., 1993), insulin-dependent diabetes mellitus (Gerstein, 1994; Mayer et al., 1988), Crohn's disease (Koletzo et al., 1989; Rigas et al., 1993), ulcerative colitis (Rigas et al., 1993), lymphoma (Davis et al., 1988), allergic diseases (Lucas et al., 1990; Saarinen and Kajosaari, 1995), and other chronic digestive diseases (Sveger, 1985). According to the AAP, breastfeeding also enhances cognitive development (Lucas et al., 1992; Morrow-Tlucak et al., 1988; Rogan and Gladen, 1993). A number of studies indicate possible health benefits for mothers as well, specifically, a reduction in hip fractures after menopause (Cumming and Klineberg, 1993), less postpartum bleeding (Chua et al., 1994), and reduced risk of ovarian cancer (Rosenblatt and Thomas, 1993) and premenopausal breast cancer (Newcomb et al., 1994).

Some studies contradict these findings and show no protective effect of breastfeeding, thus raising doubt about the importance of breastfeeding to public health. Some studies' methodology and analytical limitations resulted in ambiguous findings:

Lack of control of confounding factors. The groups to be compared should match as closely as possible for potentially confounding variables that might affect infants' health, such as family size, mother's education level, socioeconomic status, whether a parent smokes, and use of day care. Some of the studies conducted

before the mid-1980's did not always match groups by these important variables.

Problems related to the definition and duration of breastfeeding. Explicit definitions of breastfeeding practices are important for understanding and comparing studies. Some researchers classified infants as "breastfed" if they received any amount of breast milk at any time. Researchers may have called "breastfed infants" those who were offered breast milk only once or twice in the hospital, as well as those exclusively breastfed for 4-6 months. Such a mixing of groups studied could, for example, mask any protective effects of breastfeeding.

Problems related to "assignment" or reverse causality. This is a little more subtle bias, but one that can have an important impact. In studies of infant feeding and health, this bias can stem from the fact that an infant's health can affect its feeding. So, if the mode of feeding is measured after an illness has begun, it may not be clear, for example, whether a formula-fed infant became ill as a result of formula feeding or whether breastfeeding was curtailed as a result of the illness. The illness in question, then, must be unambiguously associated with the feeding method used just before the onset of illness.

Economic Benefits

In addition to individual health benefits, breastfeeding may provide significant economic benefits in terms of defraying or reducing both direct and indirect costs. The direct costs that might be reduced or averted would relate, of course, to physician, clinic, hospital, laboratory, and procedural fees. Other direct economic benefits to a family may be no or reduced costs to buy infant formula for the first year after birth. Possible indirect costs may relate to time and wages lost by parents (primarily mothers) attending to an ill child. Ideally, attributing costs to time and wages lost by parents attending a sick child should be considered when estimating the possible economic benefits of breastfeeding. Many women return to work before a child is 1 year old (Cohen et al., 1995). When these women miss work, it often is because their infants are ill. As breastfed infants have been shown to be less likely to catch common infectious illnesses than formula-fed infants, it is possible that mothers who breastfeed may miss fewer days from work to care for a sick child than mothers who feed formula.

Previous Studies

Relatively few studies have assessed the economic benefits of breastfeeding in the United States. Some earlier studies in the literature looked at the economic effect of breastfeeding in the context of comparing breastfeeding with formula feeding within the U.S. Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). WIC is the largest purchaser of infant formula, buying approximately 40 percent of all formula sold in the United States. The cost of infant formula distributed to WIC mothers in 1997 was $567 million after formula company rebates of about $1.2 billion to WIC. WIC has promoted breastfeeding, both inside and outside the Agency, including establishing a Breastfeeding Promotion Consortium to exchange information and collaborate about promoting breastfeeding. In 1996, the Department initiated an ongoing national campaign by Federal, State, and local WIC programs to promote breastfeeding to WIC mothers and to support all women who choose to breastfeed. However, advocates of breastfeeding contend that if more women breastfed, overall WIC food costs would decrease. A 1989 reauthorization of the WIC program, providing both a mandate and funding, allowed States to substantially increase breastfeeding promotion. It should be noted that WIC explicitly promotes breastfeeding because of its health benefits, not because of possible reduced food costs.

The General Accounting Office (GAO) studied in 1993 the extent to which the WIC program promoted breastfeeding and examined how increased breastfeeding would affect WIC food costs for a year (U.S. GAO, 1993). Estimating how increased breastfeeding affects overall WIC food costs was complicated by a number of factors, including the amount of supplemental formula breastfeeding infants sometimes use, the cost of food packages given to different participants (food packages provided to breastfeeding women often cost more), and the number of women served. GAO concluded that if WIC were fully funded and served all eligible recipients, any increase in breastfeeding would decrease total food costs, as long as formula-supplemented breastfed infants received no more than 25 percent of the monthly amount of formula given to formula-fed infants. GAO estimated total WIC food costs for fiscal year 1992, using 16 scenarios under varied assumptions. For one scenario, for example, GAO estimated that a 10-percent increase in breastfeeding rates, with breastfed infants receiving 25 percent of the

monthly amount of formula given to formula-fed infants, would save the WIC program almost $408,000 per year. If breastfed infants received 10 percent of the formula allowed to formula-fed infants, a 10-percent increase in breastfeeding rates would save the program approximately $750,000.

Tuttle and Dewey (1996) simulated a model of potential public cost savings for four social service programs—Medi-cal (Medicaid in California), Aid for Families with Dependent Children (AFDC), WIC, and Food Stamps—if breastfeeding rates increased among Hmong (Laotian) women enrolled in WIC in California. Initiation of breastfeeding among Hmong immigrants in the United States is low (about 12 percent). In this analysis, the authors estimated the cost savings if Hmong women breastfed fully for at least 6 months. The calculated savings were based on estimates of the resulting decrease in family size, infant morbidity, and WIC formula purchases. The authors used a 7½-year interval to illustrate potential cost savings over time based on the effects of changing family size. In part, cost calculations were based on expected differences in fertility between breastfeeding and formula-feeding women because many Asian families use breastfeeding to space births. Estimates of the impact of breastfeeding on morbidity were based on two earlier studies that indicated breastfeeding protected against gastrointestinal infections and otitis media (Howie et al., 1990; Lopez et al., 1990). Costs for WIC were calculated using figures for voucher packets provided to California clinics (costs included rebates given to WIC for family vouchers redeemed at grocery stores). Other cost savings associated with reductions were calculated on the basis of California Medi-Cal reimbursement levels and standard AFDC and Food Stamp payment rates. Costs for all four public assistance programs were projected over this 7½-year period, and future values were discounted at 0, 2, and 4 percent.[2] This study estimated yearly savings between $450 and $650 (4 percent discount) and $590 and $800 (0 percent discount) per family. Despite self-described limitations of this study (for example, results were specific to Hmong immigrant population and focused only on savings to specific public assistance programs), this analysis provided evidence that breastfeeding is economically advantageous.

[2]Costs or benefits occurring at different points in time must be brought into a common measure; discounting of future costs or benefits is necessary because it is preferable to have a given amount now than in the future; a discount rate is the inverse of an interest rate, except divide instead of multiply.

Montgomery and Splett (1997), on the other hand, tracked cohorts of exclusively breastfed and formula-fed infants for 6 months in Colorado to compare WIC costs and Medicaid expenditures. The breastfed sample included infants breastfed exclusively for at least 3 months. WIC costs included redeemed WIC vouchers for formula and foods for infants and mothers, plus administrative expenses for 6 months, minus manufacturers' rebates for formula. The benefit measure was determined from Medicaid expenditures for health care initiated in the first 6 months for each infant. The authors estimated that, compared with formula feeding, breastfeeding each infant enrolled in WIC saved $478 in WIC costs and Medicaid expenditures (1993 dollars) during the first 6 months of an infant's life, or $161 after consideration of the formula manufacturers' rebate. Although acknowledging possible incomplete Medicaid expenditures or inconsistent or uneven billing procedures, the authors argued that promotion of breastfeeding among a low-income population through nutrition programs, such as WIC, could effectively contain costs.

A few studies attempted to analyze the economic advantages of breastfeeding outside the WIC program. Jarosz (1993) conducted a study in Hawaii to estimate, for the first 62 days of an infant's life, the cost of infant formula and the cost of food a mother needs to consume to produce breast milk. The study assumed that the dietary energy needs were the same in both formula-and breast-fed infants, but that the total food intake needed by the breastfeeding mother was 21 percent greater than that needed by her baby. Different formula brands and food items for breastfeeding mothers were surveyed and priced from a sample of stores. Based on the author's estimates, it would cost an extra $45 to $70 (1991 dollars) to feed a newborn formula for 62 days or, according to the author, two newborns could be breastfed for the cost of one newborn who is formula-fed.

Hoey and Ware (1997) performed a pilot study on newborns born to mothers in a health maintenance organization (HMO) in North Carolina. They analyzed medical care and costs for the first 12 months for infants that breastfed for at least 6 months and for infants formula-fed since birth. Medical services included office visits, drug prescriptions, and hospitalizations. Although both groups of infants had similar numbers of office visits and pharmacy costs, breastfed infants had fewer inpatient admissions, and their total medical costs averaged $200 less than those of formula-fed infants. Again, this was a pilot study with a rel-

atively small sample size. The authors failed to control for demographic factors or determine the clinical severity of each medical encounter. This study contributed to a body of evidence that points to potential economic advantages of breastfeeding, however.

In a more comprehensive study, which estimated national savings, Riordan (1997) calculated "additional" health-care costs incurred to treat four medical conditions if infants were not breastfed. These four medical conditions were infant diarrhea, respiratory syncytial virus, insulin-dependent diabetes mellitus, and otitis media. For each medical condition, Riordan garnered reported incidence rates and treatment costs, and calculated costs avoided by breastfeeding. Thus, for example, Riordan indicated that 90,000 infants were admitted to hospitals for respiratory syncytial virus (Institute of Medicine, 1985). Riordan pointed to two studies that indicated that breastfed babies were about half as likely to be hospitalized with respiratory syncytial virus as formula-fed babies (Okamoto and Orgu, 1989; Pullam et al., 1980). Citing an average cost of $5,000 for hospitalizing an infant for this illness, and multiplying this figure by 90,000, Riordan stated that $450 million was spent on hospitalizations annually for this illness. Riordan indicated that half of this amount, $225 million, was an "extra" cost that could be avoided by breastfeeding. Following this rationale and procedure for each of the other three medical conditions, Riordan estimated a range of $1.1 to $1.32 billion of extra health-care costs each year for not breastfeeding. Given that Riordan cited a dollar amount from a different year for each medical diagnosis, it was not clear if this range reflected an adjustment to a base year. Riordan assumed that admission rates reflected infants not already breastfeeding—for example, the 90,000-infant admission figure used for the respiratory syncytial virus estimate assumed that none of these infants were breastfeeding but that if they did breastfeed, only 45,000 would have been admitted—a tenuous assumption at best. Regardless, Riordan indicated that these dollar estimates were conservative since they did not include parents' lost work time, were often confined only to hospital costs, and did not include other costs associated with ill children.

In a more recent study, Ball and Wright (1999) attempted to determine the excess cost of health care services for three illnesses in formula-fed infants by examining the frequency of health service use (e.g., office visits, hospitalizations, and prescriptions) in the first year of life. The data were obtained from a study conducted in Arizona that looked at the incidence of lower respiratory illness and otitis media (Wright et al., 1989), and a study conducted in Scotland that focused on gastrointestinal illness among infants (Howie et al., 1990). The authors estimated that, in the first year of life, after adjusting for confounders, there were 2,033 excess office visits, 212 excess days of hospitalization, and 609 excess prescriptions for these 3 illnesses per 1,000 non-breastfed infants compared with 1,000 infants exclusively breastfed for at least 3 months. These additional services were estimated to cost between $331 and $475 per never-breastfed infant during the first year of life. In this study, direct medical costs were based on the experience of a large HMO clinic in Arizona. The authors believed that these estimates of excess costs for care were conservative because: (1) health care costs in Arizona are below the national average, and (2) the study considered only direct medical costs. Despite these limitations, this study demonstrated rather substantial cost savings expected during the first year of life.

Estimation of Benefits of Increasing the Prevalence of Exclusive Breastfeeding

Despite caveats regarding methodology, all these studies contribute to a body of evidence that breastfeeding may be economically advantageous as well as nutritionally sound. This report estimates the economic benefits from a different perspective. For this preliminary analysis, the economic benefits of breastfeeding reflect the cost savings that would occur if the nationwide prevalence of exclusive breastfeeding, either at hospital discharge or at 5-6 months, increased from present levels to that recommended by the Surgeon General.

Methodology

Given that exclusively breastfed infants have fewer illnesses compared with formula-fed infants, it follows that, as the prevalence of breastfeeding increases, the total number of infants who become ill should decline. The benefits of increasing the prevalence of breastfeeding at 5-6 months, for example, from 29 to 50 percent can be estimated by first calculating the number of infants who are expected to become ill when the prevalence of breastfeeding is 29 percent, and then calculating the number of infants expected to become ill when the prevalence is 50 percent.

This analysis uses incidence rates from the published studies to estimate the reduced number of cases of illness that could be expected for varying prevalences of breastfeeding for the following illnesses: otitis media, necrotizing enterocolitis, and gastroenteritis. Cost data, both direct and indirect, are derived from published literature and/or extracted from U.S. Government sources.

Obviously, some illnesses related to infant feeding may have major long-term impacts on quality of life—sequelae that could increase costs significantly. However, this analysis examines only short-term considerations—benefits or costs that can be assessed by the end of the first or second year of life when morbidity rates of breastfed infants can best be compared with those of formula-fed infants.

Otitis Media

The term "otitis media" (OM), or inflammation of the middle ear, often is used to describe any one of a continuum of related diseases: acute otitis media, recurrent acute otitis media, otitis media with effusion, and chronic otitis media with effusion. In 1990, OM was the most frequently reported morbidity-related principal diagnosis for children under the age of 2 years (Scappert, 1992). OM accounts for 20-40 percent of office visits for children in the first 5 years (Faden et al., 1998). Each year, there are an estimated 30 million visits to pediatricians to treat OM infections and their sequelae, at an estimated cost of $1 billion. Most initial episodes of OM occur when a child is 6 months old (Facione, 1990).

Duffy et al. (1997), investigating the effects of breast and formula feeding on episodes of OM (both acute and with effusion), found that the incidence of OM at 6 months for exclusively breastfed infants was 25 percent, compared with 53 percent for formula-fed infants. These incidence rates can be applied to the U.S. population to determine the number of cases of OM that can be expected for given prevalences of breastfeeding. The latest birth statistics for the Nation (U.S. Department of Health and Human Services, 2000) indicate there were 3.9 million births in 1998. If the prevalence of exclusive breastfeeding at 6 months is 29 percent, we can expect 1,131,000 to receive breast milk (i.e., 3.9 million x .29). According to Duffy, we would expect approximately 282,750 cases (1,131,000 x .25) of OM for these infants in the first 6 months. In this scenario, 71 percent of the newborns—2,769,000 infants—would receive formula. Using Duffy's incidence rate, we expect a total number of OM cases for these formula-fed infants in the first 6 months to be 1,467,570 (2,769,000 x .53). Therefore, for a 29-percent prevalence of exclusive breastfeeding at 6 months, we expect a total number of cases of OM in the first 6 months to be 1,750,320 (282,750 breastfed, 1,467,550 formula-fed).

This same procedure may be used to calculate the number of cases of OM that would be expected for a 50-percent prevalence of exclusive breastfeeding at 6 months. In this case, 1,950,000 infants would be breastfed. Of these infants, we would expect 487,500 cases of OM (1,950,000 x .25). We would also expect that 1,950,000 infants would receive formula, of which 1,033,500 (1,950,000 x .53) would have an incidence of OM. The total number of cases of OM under this prevalency rate (that recommended by the Surgeon General) would be 1,521,000. This represents a reduction of 229,320 cases from the 29-percent prevalence rate scenario (1,750,320 – 1,521,000).

The savings due to this reduction can be calculated by referring to published cost estimates. The Agency for Health Care Policy and Research (AHCPR) conducted a cost analysis using charges recorded in a health claims data base compiled from over 100 insurance companies (U.S. Department of Health and Human Services, 1994). Indirect cost estimates were based on time and wages lost by parents. The AHCPR estimated an average cost per case across all treatment categories (nonsurgical and surgical) to be $1,330 (1991 dollars). Adjusting this figure to 1998 dollars resulted in an estimated cost of $1,592. Applying this cost estimate to the number of reduced cases of OM due to an increase of breastfeeding prevalency at 6 months from 29 to 50 percent totals $365,077,440 ($1,592 x 229,320) in estimated savings. Table 1 summarizes information about the number of cases of OM and associated costs for varying prevalences of breastfeeding and formula feeding.

Gastroenteritis

Gastroenteritis, for this report, is described as vomiting or diarrhea, or both, lasting as a discrete illness for a 24-hour period. Diarrhea, specifically, is traditionally defined as three or more watery or semi-watery stools in a 24-hour period. Gastroenteritis illness remains a major cause of morbidity and mortality in developing countries, and remains prevalent even in developed

Table 1—Otitis media (OM): Number of cases and cost for various rates of breastfeeding at 6 months

Breastfed infants		Formula-fed infants		Totals	
Prevalence	OM cases	Prevalence	OM cases	OM cases	Cost of OM
Percent	*Number*	*Percent*	*Number*	*Number*	*Dollars*
29	**282,750**	**71**	**1,467,570**	**1,750,320**	**2,786,509,440**
40	390,000	60	1,240,200	1,630,200	2,595,278,400
50	**487,500**	**50**	**1,033,500**	**1,521,000**	**2,421,432,000**
60	585,000	40	826,800	1,411,800	2,247,585,600

Incidence in breastfed infants = 25 percent.
Incidence in formula-fed infants = 53 percent.
Bold-faced figures refer to examples cited in text.
Source: Duffy et al. (1997).

countries. It has been estimated that, in the United States, 16.5 million children less than 5 years of age have between 21 and 37 million episodes of diarrhea annually (Glass et al., 1991). Breastfeeding is thought to confer some protection against diarrhea in infants because of two likely mechanisms: (1) supplementation with formula or other food carries risk for nonhygienic conditions of introducing pathogens to an infant's system; and (2) breastmilk contains immunoglobulins that increase an infant's resistance to infection.

A number of studies, for example, Howie et al. (1990) and Dewey et al. (1995), examined the differences in morbidity between breastfed and formula-fed infants. Dewey found that the incidence of diarrheal illness in the first year for exclusively breastfed infants was 14 percent, compared with 31 percent for formula-fed babies.

Again, if the breastfeeding prevalency rate at 6 months is 29 percent, 1,131,000 babies are breastfed, and there would be 158,340 expected cases of diarrheal illness among these infants (.14 x 1,131,000). Seventy-one percent, or 2,769,000 infants, would be formula-fed, and there would be 858,390 expected cases of diarrheal illness among these infants, for a total number of cases of diarrheal illness of 1,016,730.

If the breastfeeding prevalence rate at 6 months were to increase to 50 percent, 1,950,000 infants would be breastfed, and there would be 273,000 expected cases of diarrhea (1,950,000 x .14). For the other 50 percent, or 1,950,000 infants that would receive formula, there would be an expected 604,500 cases of diarrhea, for a total case number of 877,500 under this prevalency rate.

Increasing the breastfeeding prevalency rate at 6 months from 29 to 50 percent, then, would result in an expected reduction of 139,230 cases of gastroenteritis (1,016,730-877,500). Glass et al. (1991) found that 10 percent of gastroenteritis in infants prompted physician visits, and that 1 percent led to hospitalization.

If we assume that 10 percent of the 139,230 cases would have led to physician visits, there would be 13,923 such visits. Avendano et al. (1993) estimated that an average cost per episode of diarrhea (physician's visit) was $289 (1993 dollars). This cost included traditional medical expenditures (for example, office visit, laboratory tests, etc.) as well as indirect costs associated with parents' missed time from work and extra childcare due to parents' absence from the home. Tucker (1998) estimated that the average hospital cost for a case of diarrhea would be $3,622, with additional nonmedical costs (for example, forgone earnings of parents, travel, etc.) estimated at $100 (1996 dollars). One percent of the 139,230 cases leading to hospitalization equates to 1,392 cases.

Converting these costs to 1998 dollars resulted in an estimated savings for reduced physician visits of $4,552,821, and savings for reduced hospitalizations of $5,388,432, for a total savings of $9,941,253. Table 2 shows information on the number of cases of gastroenteritis and associated costs for varying prevalences of breastfeeding and formula feeding at 6 months.

Table 2—Gastroenteritis (GE): Number of cases and cost for various rates of breastfeeding at 6 months

Breastfed infants		Formula-fed infants		Totals	
Prevalence	GE cases	Prevalence	GE cases	GE cases	Cost of GE
Percent	*Number*	*Percent*	*Number*	*Number*	*Dollars*
29	**158,340**	**71**	**858,390**	1,016,730	72,593,361
40	218,400	60	725,400	943,800	67,387,320
50	**273,000**	**50**	**604,500**	877,500	62,653,500
60	327,600	40	483,600	811,200	57,919,680

Incidence in breastfed infants = 14 percent.
Incidence in formula-fed infants = 31 percent.
Bold-faced figures refer to examples cited in text.
Source: Dewey et al. (1995).

Necrotizing Enterocolitis

Necrotizing enterocolitis (NEC) is the pre-eminent gastrointestinal tract disease encountered in the neonatal intensive care unit. It is an important cause of neonatal death and is the leading cause of emergency surgical treatment in newborns (Neu, 1996). Over 90 percent of NEC cases affect premature infants. Incidence approaches 12 percent of all premature infants with birthweight of less than 1,500 grams (Caplan and Mackendrick, 1993). The onset of NEC is within the first 10 days of life in 90 percent of the cases. Infants with NEC have various signs and symptoms, the most benign of which are feeding intolerance, abdominal distension, and changes in stool patterns. More severe characteristics are abdominal tenderness, bloody stools, intestinal gangrene, bowel perforation, sepsis, and shock (Caplan and Mackendrick, 1993). Lucas and Cole (1990) conducted a randomized controlled trial investigating the effects of breastfeeding and formula feeding. The incidence of NEC in exclusively breastfed low-birthweight (LBW) infants was 1 percent, compared with an incidence of 7 percent in formula-fed LBW infants. Latest statistics indicate that 291,000 LBW infants were born in the United States in 1997 (U.S. Department of Health and Human Services, 1999).[3]

Given that the onset of NEC generally occurs within the first month of an infant's life, using breastfeeding prevalency rates at 6 months to estimate potential benefits is inappropriate. Rather, the breastfeeding prevalency rate at hospital discharge provides a more rational framework with which to gauge potential economic benefits of this feeding mode, in terms of reducing the number of infants who become ill.

If the prevalence of exclusive breastfeeding in the hospital were currently 64 percent, then we would expect that 186,240 infants would be breastfed, among whom we would expect 1,862 (1 percent) cases of NEC. Thirty-six percent or 104,760 newborns would be formula-fed, and 7 percent of these, 7,733, would be expected to contract NEC, for a total number of NEC cases of 9,195.

At the Surgeon General's recommended 75-percent prevalency rate for breastfeeding in the hospital, 218,250 LBW infants would receive breastmilk with an expected 2,182 cases (1 percent) of NEC. Under this scenario, 25 percent or 72,750 LBW infants would be formula-fed and 5,092, or 7 percent, of these LBW babies would be expected to have NEC, for a total number of cases of 7,274. Total reduction in the expected number of LBW infants contracting NEC as a result of increased breastfeeding is 1,921 (9,195 - 7,274).

According to Stoll (1994), 40 percent of infants who have NEC have surgery. Data from a Government nationwide study sample of inpatients (U.S Department of Health and Human Services, 1996) indicate that the average length of stay at a hospital for an infant with NEC is 38.9 days (39, rounded), at

[3]LBW infants are defined as those whose birth weight is between 1,500 and 2,500 grams (approximately between 3⅓ and 5½ pounds).

an average cost of $118,240 (physician's charges not included). Assuming that 40 percent of the reduced number of NEC cases would have had surgery (768), savings from increased breastfeeding are estimated to be a minimum of $90,808,320.

Additional societal costs saved from increasing the breastfeeding rate from 64 to 75 percent relate to parents' time and lost wages. We assume that at least one parent would spend a minimum of 4 hours a day with a hospitalized child during the 39-day hospital stay. Data from the U.S. Bureau of the Census (1998) indicate that 91 percent of children under 18 years of age live in households with their mother (mother only, or mother with another adult). The Bureau of Labor Statistics (1999) indicates that, for 1998, the mean hourly earnings rate of female wage and salary workers was $9.37 (ages 20-34); for men in this age range, the mean hourly earnings rate was $10.82. Assuming that 91 percent of the 768 children who would require NEC surgery would be cared for by their mother, the resultant savings from an increased incidence of breastfeeding is $1,021,742 (699 children x 4 hours x 39 days x $9.37). Assuming that the remaining 9 percent of the children would be attended by their fathers, the estimated cost is $116,466 (69 children x 4 hours x 39 days x $10.82). Total costs attributed to parents' time and lost wages, then, is $1,138,208.

Finally, based on research from a number of investigators, for example, Stoll (1994) and Jayanthi (1998), the NEC mortality rate (again, the third leading cause of death in newborns) is estimated to be between 15 and 25 percent (in the first year). Valuing premature death at $8.3 million and using the midpoint of this mortality rate range (20 percent), the total value lost is estimated to be $3,187,200,000.[4] Total savings—hospital care, parents' time and wages, and deaths—are estimated to be $3,279,146,528. Table 3 depicts the number of cases and associated costs of NEC for LBW infants for varying prevalences of breastfeeding and formula feeding in the hospital.

[4]There is no consensus on how to best value premature death, but one of two approaches is typically used. The human capital approach estimates a value for a statistical life using average wages adjusted by a risk premium derived from life insurance studies. The labor market approach (used in this report) estimates a value based on the higher wages people demand for accepting risky jobs. The labor market approach values the cost of a death of a male infant at $8.3 million, and $8.5 million for a female infant (1998 dollars). The values for males and females differ because of higher average life expectancy for females. In this study, the $8.3 million figure is used for all infants (see Frenzen et al., 1999).

Table 3—Necrotizing enterocolitis (NEC): Number of cases and costs for various rates of breastfeeding for low birth weight infants (LBW) at hospital discharge

Breastfed infants (LBW)		Formula-fed infants (LBW)		Totals	
Prevalence	NEC cases	Prevalence	NEC cases	NEC cases	Cost of NEC
Percent	*Number*	*Percent*	*Number*	*Number*	*Dollars*
64	**1,862**	**36**	**7,333**	**9,195**	**15,704,037,798**
70	2,037	30	6,111	8,148	13,919,174,183
75	**2,182**	**25**	**5,092**	**7,274**	**12,424,891,270**
80	2,328	20	4,074	6,402	10,930,608,131

Incidence in breastfed infants = 1 percent.
Incidence in formula-fed infants = 7 percent.
Bold-faced figures refer to examples cited in text.
Source: Lucas et al. (1990).

Conclusions

Federal and public-health policies promote breastfeeding because breastfed infants are healthier. Economics can identify the economic consequences of increased breastfeeding by measuring the reduction in medical and other costs associated with having healthier babies. Many prior studies looked at the cost-effectiveness of breastfeeding from the individual's perspective. This study goes one step further to measure reduced costs to society as childhood illnesses and premature deaths are prevented.

This preliminary analysis of breastfeeding and formula feeding indicates that a minimum of $3.6 billion would be saved if the prevalence of exclusive breastfeeding increased from current rates (64 percent in-hospital, 29 percent at 6 months) to those recommended by the Surgeon General (75 and 50 percent, respectively). This figure reflects approximately $3.1 billion attributable to preventing premature deaths, and an additional $0.5 billion annual savings associated with reducing traditional medical expenditures (for example, office or hospital visits, laboratory tests, etc.) and indirect costs such as forgone earnings of parents, among others.

This figure probably underestimates the total savings likely. This figure represents only cost savings due to reduced costs to treat three childhood illness; it excludes the cost of purchases for over-the-counter medications for treatment of OM and gastroenteritis symptoms, physician charges related to the treatment of NEC, and cost savings due to reductions in long-term morbidity.

Although this analysis provided a perspective different from that found in previous studies, the results from this study are consistent with those from prior investigations in demonstrating that the potential for cost savings from breastfeeding is substantial. Costs of medical care continue upward. The Nation's total spending for health care in 1995 was nearly $1 trillion ($988.5 billion), an increase of 5.5 percent from the previous year, reflecting an estimated average of $3,621 per person. This figure represents 13.6 percent of the gross domestic product, a percentage approximately double that of any other developed nation (U.S. Department of Health and Human Services, 1997). Breastfeeding involves mostly primary and, to a lesser extent, secondary prevention. Primary prevention is any activity that prevents a disease from ever starting. Secondary prevention is any activity that cures or reduces the severity of a disease. As described in the introduction, the literature indicates that breastfeeding provides primary and some secondary protection against viral, bacterial, and allergic diseases. The U.S. Department of Health and Human Services' Agency for Health Care Policy and Research (AHCPR) or other Federal cost-control deliberations do not include breastfeeding, however.

Given that breastfeeding does provide immunologic protection against a variety of illnesses, health-care providers, corporate administrators, and State or Federal policymakers could see a decline in their costs for pediatric care with an increase in breastfeeding. Since managed-care plans emphasize the rewards for preventing health problems and **not** using health services, their support for breastfeeding may be a cost-effective way to keep insured clients healthy.

Undoubtedly, further research on health and cost benefits of breastfeeding is needed. Ideally, for an entire range of child-related illnesses, large-scale research studies should specifically focus on rates of hospitalization, duration of hospitalization, health-service use, and medical costs among breastfed and formula-fed infants. Much of the current available data are based on studies in specific locales (for example, clinics or local hospitals). Some data are available from large-scale epidemiological research. However, as Riordan (1997) pointed out, there are problems conducting epidemiological research on breastfeeding in this country, which lacks a central data source for infant morbidity and mortality. She notes, for example, that the only purportedly reliable data about breastfeeding rates are from an infant formula company. The Federal Government (the Centers for Disease Control and Prevention, for example) publishes data about selected childhood diagnoses, but much of the reported data are categorized according to age groups (usually 0-15 years) that do not separate out the first or second year of life—years when breastfed infant morbidity can best be compared with that of formula-fed infants.

The data used in this report reflect estimates garnered from incidence rates, treatment costs, and calculated potential savings generated by breastfeeding based on disparate, sometimes local sources. The beneficial effects of breastfeeding are likely greater than those shown here and in other studies. Given these caveats, however, without such health and cost benefit studies, employers, insurance companies and Federal health policymakers are unlikely to provide financial incentives either to encourage breastfeeding or to encourage health care providers (including physicians) to provide better support and care for breastfeeding mothers.

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