Benefit/Cost Analysis
of the Memphis New-Mothers Nurse Intervention

by

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I. Introduction

Children born into low-income, single parent families have well-documented difficulties, including low birth weight, increased mortality, developmental retardation, and (later in life) higher incidence of child abuse and neglect, schooling difficulties, and social dysfunction. Some of these problems carry into and create further problems in the adult lives of these children. The Young Mothers project in Memphis tests a carefully designed intervention with nurse visitation to eligible mothers in their first pregnancy, the purpose of which is to reduce the rate at which these poor outcomes occur. The design and logic behind the intervention are documented elsewhere (Olds, 1988). In this paper, we develop plans for analyzing the benefits and costs of the intervention.

Costs of the program include two categories; those necessary for the ongoing conduct of the intervention (which costs would continue in an ongoing project) and evaluation costs (that occur only in this project). We include only the former in the benefit/cost evaluation of the New Mothers intervention. In general, these include the costs of the nurse visitation team plus the costs of any increased community services used by the mothers and their children, compared with the control group. Because the nurse intervention may increase referrals to community agencies, the latter category may constitute an important part of total program costs.

Benefits from the project fall into two categories, one of which we measure directly ("tangible" benefits), and the other of which we can only indirectly infer ("intangible" benefits). Each of these categories of benefits has two sub-categories in turn --(a) benefits accruing to governments, community agencies, and the community in general and (b) benefits accruing to the mothers and children. In some cases, we can measure the second group (benefits accruing to mothers and children) only imperfectly, if at all. Because of the presumed importance of government benefits (cost savings from other government programs) in government decisions regarding nurse home visitation programs, we will particularly emphasize the careful accounting of costs and cost-savings.
(benefits) to governments as part of our analysis.

Finally, some benefits occur immediately (current) and some with a delay (future). We will measure all benefits (and all costs) in 1990 dollars, adjusting from year to year using the consumer price index (CPI). In order to make current costs and future benefits commensurate, we will discount all inflation-adjusted future benefits, using standard economic methods. We will use a "real" discount rate of 3 to 5 percent. Note that this discounting takes place after we have adjusted all costs to 1990 dollars; it accounts for the time value of money, rather than adjusting for inflation (which the CPI adjustment accomplishes).

We cannot measure all of these benefits precisely, and some not at all. Thus, while our measure of costs should be relatively all-inclusive, our measures of benefits will understate total benefits. We will estimate all categories of benefits where a meaningful method exists, but our most conservative measure of the benefits will include only those that we can directly quantify. Figure 1 shows these categories of benefits, providing examples of each class of benefit as appropriate.

[Figure 1 here]

II. Program Cost Estimation

In the context of this home-visiting program, the concept of "cost" includes:

a. The immediate financial outlay directly attributable to the home-visiting service;

b. Secondary costs resulting directly or indirectly from implementation of the service.

We have made provisions for keeping track of relevant program cost information, but find that we must consider a number of fundamental conceptual issues in arriving at "true" program costs. To address this issue we intend to provide three types of estimates and carry out sensitivity analysis using a range of program cost estimates.

All three estimates of program cost will include the 1) the cost of our subcontract with the Shelby County Health Department beginning June 1, 1991, the date that we began the randomization
of patients in the main study; 2) the cost of additional course-work/training paid by the University of Rochester for the nurses in preparing them for their roles as home visitors; the involvement of Harriet Kitzman, Ph.D., R.N. (half of the time that she devotes to the project) and Mary Sprik, Ph.D., R.N. (all of her time spent on the project) in orienting the nurses to the program and providing them with clinical leadership; and 3) the costs of the nurses' "moonlighting" with the University of Rochester to provide monthly dictated tapes on selected families to form a data base for a qualitative analysis of program implementation.

The moonlighting costs are perhaps the most controversial. The moonlighting work is important for the formative evaluation of the program, but one of the primary purposes of our offering the moonlighting opportunity to the nurses was to help augment the suboptimal salaries offered by the health department, and thus to reduce staff turn-over. The offer of moonlighting work and educational benefits are the types of incentives that we believe most health departments will have to offer in order to attract and retain qualified nurses for these roles. For this reason, we have included these costs as part of our base estimate.

The three estimates outlined below differ in their methods of handling the following costs: 1) "sunk" costs (the costs of program development), 2) the efforts of research staff in supporting the ongoing implementation of the program, and 3) the additional time (or inefficiencies) spent in carrying out the program because of its integration into a research project.

Option one includes, in addition to the base costs outlined above, the "sunk" costs in program development (all costs of the Shelby County Health-Department experienced during the year prior to the start of the main study), 2) the research staff time involved in program implementation, and 3) the additional record keeping time required by the research. If research staff were not involved in supporting program implementation, then someone in comparable positions would need to fulfill these roles. This is the most conservative estimate.
The second option also includes the base costs outlined above, but makes an effort to separate those additional program costs due to the research. Those costs include that part of program development work carried out prior to the beginning of the main study that would not need to be repeated now that the program protocol is well developed, and the additional time required to gather data for research purposes. Here the estimates of staff time devoted to program development versus implementation are based entirely on the judgments of the senior staff of the project. Given their extensive experience with the program, they are in a firm position to estimate those portions of their time devoted to each activity.

For options one and two we will apportion the total cost of the program among individual families, based on each of the nurses' records of how much time they spend on each family in the following activities: home-visits, travel, and phone calls with individual families. Each subject (treatment or control) will be assigned an individual program cost value, based on the estimated amount of resources they consume. This approach allows a potentially important analysis of subgroups of individuals, identifying groups that are relatively more or less costly for program implementation. We will separately study how benefits differ among such subgroups, and hence be able to calculate incremental cost-benefit estimates for identifiable subgroups. This may allow more efficient targeting of the program in future applications.

The third approach takes the position that sufficiently many inefficiencies occur in this research-based program to make it unrepresentative of other programs that might be carried out. It is therefore necessary to estimate what it would cost to develop such a program in other settings (now that the program model is fully developed) and where the program would not be tied to the research. This approach would basically use a "human resources engineering" or "time and motion" model to construct program cost estimates from the ground-up. This is the sort of cost estimation that firms must do all the time when they bid on projects that have yet to be undertaken. Thus, it
is a very common approach to cost estimation.

To do this sort of cost estimation, one begins by estimating the case load that a typical nurse-visitor is capable of handling in the steady state. One then adds other costs associated with each home-visitor, including office, phone, transportation, supervision, consultation by physicians, psychologists, nurses, etc. We will have a good understanding of the feasible caseload based upon our experience in Memphis (and the previous study in Elmira, see Olds et al, 1991), the extent of consultation typically used, appropriate supervisory time, etc. Another important dimension of this problem is the training time/costs associated with each staff member, and concomitantly, the turnover that one can expect in such programs. Each of these types of personnel time (and other costs such as office space, travel miles, etc.) then have costs per unit attached to them on the basis of current estimates of the relevant costs, and the total costs computed for some arbitrary program size (e.g., 100 mothers treated). The costs per mother are then readily derived.

One advantage of this approach, i.e., identifying the amounts of each input used in the project, is that it allows more refined estimates of costs for such a program in diverse areas around the country using local estimates of the relevant per-unit costs (e.g., annual salary for a qualified RN, office rental costs per square foot, etc.)

The estimation of secondary costs resulting from this program is essential if we are to arrive at a complete assessment of the cost of the program. Secondary costs consist of the costs associated with the referral of program families for other health and human services in the community. These referrals constitute a primary function of our nurse home visitors and result in increased public and private spending by these other agencies. In order to determine these costs, all program families fill out "utilization of services" questionnaires, administered three times during the 2½ year program. Responses to these questions yield an estimate of the number of times each family has used the various health and human services available in the community. An estimate of cost per unit of service
for each agency will be multiplied times the number of "uses" for each client, to give us an estimate of the secondary cost resulting from the increased use of community services attributable to various treatment conditions. We will endeavor to get true incremental costs of these services from the various programs, rather than average cost, which might inappropriately include fixed costs.

III. **Tangible Benefits**

**Non-Financial Benefits**

Some of the benefit measures have such direct importance that we wish to measure them separately, without attaching a dollar value to them. (Later measures of financial benefits will pick up some of the financial consequences of these non-financial benefits.) The most important of these events include:

**Infant Mortality.** Infant mortality provides one of the most important measures of health levels in any community. Numerous cross-national studies of health outcomes, for example, use infant mortality as a sensitive indicator of the quality of a health care system and the standard of living of a population. In our study, the expected number of perinatal and infant deaths is small -- about 10 each for treatment and control groups -- and may be too small to detect what would otherwise be meaningful differences in infant mortality. We will, however, measure infant mortality carefully as one possible outcome measure.

**Birth Weight.** Birth weight summarizes much about the health of an infant. Indeed, an OTA study on child health (US Congress, OTA, 1988) stated that "The high US infant mortality rate is brought about largely by the high rate of low birthweight in this country. Low birthweight so overwhelms other health problems of early childhood that it cannot be ignored." Low birthweight prevention has direct payoff to the US health care system, because, as the OTA study estimates, "for every low birthweight birth averted by earlier or more frequent prenatal care, the US health care
system saves between $14,000 and $30,000 in newborn hospitalization and rehospitalization costs in the first year, and long-term health care costs associated with low birthweight."

**Child Spacing and Family Size.** Since the amount of money from government agencies dealing with families is a function of the number of individuals in the household, the number of children borne by a woman has considerable importance. If intervention decreases the number of children within the family, demands on various governmental agencies’ resources fall. Similarly, another goal of this study is to increase the spacing between children, increasing the overall well-being of the mother and her children. Increased spacing may also lead to a smaller completed family size. As the intervention is expected to decrease the number of subsequent children in the treatment groups, the amount of society’s resources demanded by the treatment families would decrease.

At the beginning and at the end of the study, the women in both the treatment and control groups are asked to indicate the number of children that they expect to have. This number can be compared on a aggregated basis to the number of children actually produced by both groups at the end of the study. This will give a tangible indication of the immediate effectiveness of the intervention on the women’s fertility rate.

**Abuse of Children and Mothers.** Since this study tracks both the mother and her children, the abuse of the mother, either by family or male companion, and the abuse of the child will be evaluated. With a self-reporting survey, we will obtain the number of mothers who were abused as children or as adolescents, since this is helps predict which of these persons will themselves become child abusers. Mothers who had themselves experienced severe physical abuse may become abusers at a rate as high as 70 percent (Egeland, Jacobvitz and Papatola, 1984). A broader review of the literature suggests that some 30 percent of these women will become abusive parents (Kaufman and Zigler, 1989). We will use the self-reports of previous abuse as a control variable in analyzing the effects of the intervention on reducing child abuse currently.
The intergenerational transfer of abusive behavior offers chance that future benefits from the intervention will occur that we cannot measure during the course of the study. The idea, upon which we elaborate later, is that prevention of child abuse in this generation will also reduce the number of abused children in future generations by a predictable amount. Since the literature does not agree completely about the rate of intergenerational transfer, we will conduct sensitivity analyses in our benefit-cost calculations, using different rates of intergenerational transfer of abusive behavior as the literature supports.

Any subsequent children will also be observed for abuse during this two year period. Abuse may be triggered by the stress of having two very young children. The subsequent children will be included in the cost/benefit analysis for the evaluation of abuse.

Financial Benefits

We can now turn to some of the events where we can measure the financial consequences of the intervention. Some of these events depend heavily on the prior findings of the non-financial benefits. (For example, reduced medical expenses will heavily depend upon reduced rates of low birthweight and child abuse.) Thus, establishing the occurrence of the relevant "events" (like reduced incidence of low birthweight) adds support to any findings of financial savings.

Medical Expenses. A primary goal of the nurse intervention is to prevent illness in the mother and infant. This reduction in illness creates both a tangible benefit (reduced medical expenses) and an intangible benefit (the extra value of the health beyond the money saved). The tangible (dollar) benefit is split between various government agencies, the private sector, and the mothers (and their families). Many (almost all) of these young mothers are eligible for Aid to Families with Dependent Children (AFDC), and receive medical assistance through the Medicaid program. Medicaid has both state and federal funding, the share paid by the state depending on the average per-capita income in the state relative to the entire country. The share paid by the state
ranges from 25 to 50 percent. Tennessee pays 30 percent of its Medicaid program costs. We will estimate the savings to each of these levels of government and to families using State data on Medicaid program costs, obtained from the Tennessee State Department of Social Services, described in further detail in a later section.

Medical care expenses fall into discrete categories that we can analyze separately, including:

- Mother's prenatal care costs
- Delivery costs
- Mother's annual non-pregnancy costs
- First Child's Hospitalization at delivery
  - Newborn intensive care possible
- First Child's well care costs
- First child's acute and chronic illness costs
  - (Emergency room costs included)
- Second and subsequent child costs (future)
  - correspond to first child.

- If number of children changes, total medical care cost savings include (costs per child) x (differences in number of children)

We will analyze these medical care costs using methods developed in the RAND Health Insurance Experiment. These studies show that the best way to analyze medical cost data splits the analysis into two components: whether or not a category of expense occurred, and (if so), how large was it. For example, if differences occur in the costs of any newborn intensive care unit (NICU) treatments, we will analyze the differences first by determining if the rate of NICU use differs by treatment vs. control groups, and second, among those entering an NICU, the expense per patient. This method of analyzing such data has been studied extensively by two separate research teams (Manning, Duan and Rogers, 1987, Hay, Leu and Rohrer, 1987). Both came to the conclusion that this so-called two-part model dominated other available approaches in providing good estimates both
of the expected value of the various outcomes (e.g., medical spending) and the effects of any explanatory variable on the outcomes (i.e., individual regression coefficients).

**Increased Earnings.** In the Elmira study (Olds et al. 1991), labor force participation increased markedly for low-income women receiving the intervention, compared with the control group. This provides the tangible benefit to the mothers and children of the increased ability to purchase desirable goods and services. We will use labor force earnings (dollars) to measure this benefit. As subsequent sections describe, this benefit is divided between the families (after-tax earnings) and government (increased tax receipts and reduced welfare payments).

**Income Tax Receipts.** In the realm of direct benefits to government, potential changes in tax receipts include three distinct categories -- income and related (FICA) taxes (to both federal and state governments), sales taxes (to state government) and changes in excise taxes on alcohol and tobacco (to federal and state governments).

Changes in income tax receipts occur automatically whenever a young mother increases her labor force earnings. The study measures earnings directly through periodic interviews, for both experimental subjects and controls. While measuring changes in income is more straightforward, measuring changes in income tax receipts presents a more complicated problem, because of the non-linear structure of the income tax system. Many of these young mothers will have zero tax liability, because their earnings minus their deductions and exemptions leave zero taxable income. This will depend not only on their earnings, but their legal filing status. If the mother is living alone and pays for more than half of the costs of keeping up the home, then the birth of a child will make the mother eligible to file as Head of Household, rather than as a single person. In 1990, gross income under $5300 (for a single person under age 65) or $6800 (for head of household under age 65) meant that the person did not have to file a tax return. (The IRS does not yet have the cutoff numbers for 1991.) Some young mothers will increase their earnings, and still not have any tax liability. For these
people, the marginal tax rate is zero.

Others will have had taxable income without the intervention, and if they increase their earnings, all of those added earnings will face a marginal tax rate of 15 percent in the IRS tax structure. (We presume that none of these mothers will reach earnings exceeding that would push them into the 28 percent tax bracket. In 1990, earnings of $25,600 for a head of household were necessary before the marginal tax rate increased to 28 percent. This income at registration would make the mother ineligible for our study.) Still a third group will have had no tax liability with pre-intervention earnings, but incur some tax liability as earnings increase. For them, the appropriate tax rate is a mix of zero (on a portion of their earnings) and 15 percent (on taxable earnings).

Given these complexities, two approaches to measuring changes in tax receipts exist. As one alternative, we could have directly asked the mothers about their tax payments in each year, possibly verified by copies of their 1040 forms. This would allow direct measure of tax receipts. An alternative, and less intrusive measure, imputes the tax liability using standard deductions and exemptions for each mother, using reported income. We are using the second, less intrusive method. The quality of data will probably not deteriorate, and may even be better than the former method, given the likely quality of financial records maintained in the eligible households.

State income tax issues are slightly different. Tennessee has no state income tax, but other states where a program might be implemented will have such taxes. To allow for this, we plan to report the federal tax changes, and presume that state tax receipts move proportionately. Thus, the total tax effect will include the federal tax changes plus an amount of state taxes that links to the relevant marginal tax rate in a state for families involved in the program.

Changes in FICA receipts are much easier to calculate, since the FICA tax is a direct proportional tax on wage income up to a maximum (exceeding $50,000 in 1990). The 1990 rate was 7.65 percent paid by the employee, and a corresponding 7.65 percent by the employer.
Sales Tax Receipts. If the intervention changes the incomes of the young mothers, then their spending on items that accrue sales taxes to the state will also increase. While the structure of these taxes differs from state to state, they generally require sales taxes on all final goods and services except for housing, food, and medical care. We will use previous studies of the patterns of spending for similarly-structured families to determine the proportion of their budgets (at different earnings levels) that would be spent on items that accrue sales taxes. We can then impute the changes in sales tax receipts for any desired tax rate, e.g., 3 percent, 5 percent, or 7 percent.

In order to make these calculations appropriately, we will have to combine their earnings data with information on their use of Food Stamps and Housing Allowance Programs. Food Stamp and housing allowance programs increase the spending power of these mothers on items that are not typically subject to sales taxes. Thus, for a given level of earnings, mothers participating in these programs will have higher amounts of income to spend on sales-taxable items than would otherwise be apparent.

We can categorize spending into six groups: food, housing, medical care, child care, income (and property) taxes, and "residual" income. We will acquire the budget shares for these categories of spending from the budget studies previously described, rather than attempting to do complete budget studies on our New Mothers subjects and controls. These studies estimate the budget share of persons within specific income groups, and how the shares change as income changes.¹ Net spending on food and housing must account for food and housing subsidy programs. Generally, sales taxes will be paid only in the category of "residual" income. Where the state sales tax rate is t, state tax receipts are \( t/(1+t) \) x residual income. Thus, changes in sales tax receipts are \( t/(1+t) \) x change in residual income.

¹ The budget shares of "luxury goods" increase as income rises, and those of "necessities" fall as income rises.
**Excise Tax Changes.** Based on results from previous studies, we anticipate that the rate of consumption of two commodities -- tobacco and alcohol -- will diminish in the control group. These changes produce known and documented health benefits for the mothers and children, and will reduce medical care costs for both. However, to keep the government receipts accounting complete, we will also measure changes in excise tax revenue by governments. Both federal and state (and sometimes, local) governments impose excise taxes on alcohol and tobacco. These tax receipts will fall if use of those commodities falls. We will estimate the change in government excise tax receipts by estimating changes in consumption of these commodities and applying the prevailing federal and state excise tax rates (per item) to these changes. Government receipts on gasoline taxes may increase if the mothers' incomes rise sufficiently to allow purchase of a vehicle, but we do not measure either vehicular ownership or miles driven, and thus will ignore this category of tax receipts.

**Aid to Families with Dependent Children (AFDC)**

Since the amount of Aid to Dependent Children (AFDC) is directly related to the number of children that a woman has, the size of a woman's family is important in determining the cost of AFDC to society. If intervention will result in fewer subsequent pregnancies, then AFDC payments will be decreased, a direct savings to society. Correspondingly, if a woman's fertility rate is not decreased, then AFDC payments will be remain as high as the control group and result in a higher cost to society.

We have two independent methods to estimate AFDC costs. First, the amounts of AFDC payments to the treatment group and the control group can be directly calculated by using the government subsidy rate times the number of eligible persons in each family. Alternatively, we will obtain a direct measure of AFDC payments from the State files, matching AFDC recipients' files to persons in our study. We have chosen the second method and, as indicated below, have established the procedures for obtaining these data.
While the study's duration will not allow us to observe completed family size, we can estimate future AFDC payments by using the information on AFDC payment and eligibility rules and the projected number of children in the treatment and control groups. This approach recognizes that the benefits from this intervention may endure long beyond the actual time of home visitation.

Charitable Care Costs

The study's effectiveness will be evaluated in terms of the differential demands upon the charitable resources in the Memphis community. Specific agencies in the Memphis area will need to be identified. In general terms, these will include agencies dealing with drug use, prostitution, supplemental food, shelters from abuse (note that this will not be double counted), day care centers, counseling services, literacy volunteer groups and emergency aide of food and clothing. We will obtain the average cost per visit or use of these agencies and multiply this figure times the number of people in this study who normally use these services. Note that the intervention has components that may decrease the use of such services (e.g. preventive) and those that may increase the use of them (enhanced awareness of availability of appropriate services).

Food Stamps

Low income people who are entitled to food stamps buy one dollar of food stamps for an amount less than one dollar. The difference between the purchase price and one dollar is the amount of the government subsidy, and therefore a cost. We will determine the schedule of food stamp subsidies from the Tennessee state government and estimate the amount of subsidies that are given to these women for our cost/benefit analysis.

Measurement Issues

We have completed negotiations with the Tennessee State Department of Human Services to derive exact state costs for these services on an individual basis. They have agreed to provide us
with data from State records on Medicaid charges, welfare services, and food stamps. We will have to estimate child-abuse and neglect costs based on the level of department involvement with individual cases, which we will have.

Since we will rely extensively on State computer files for four areas (AFDC, Food Stamps, Medicaid costs, and Child Abuse program costs), we have established a rigorous protocol to make certain that the data we receive from State files correspond to the persons enrolled in our study. The initial match takes place on Social Security Number (SSN). Since the possibility exists that an incorrect match would take place if the SSN is incorrect (but corresponded to another real person in the Tennessee files), we will also require matching on Date of Birth (DOB) and either initials or last name. If the DOB matches in two of three categories (e.g., month/year or month/day), and we can match on name, we will consider the match complete. In some cases, we anticipate that variations in spelling of name may require that we match by hand in a few cases.

The Tennessee Department of Health and Human Services has agreed to make the matches and extract the files for our enrollees using the matching algorithms we have devised (as outlined above). They will undertake the extraction of data for our enrollees because the files are too large to send the entire files to us. They are preparing a cost estimate for this extraction currently. Matching on the Child Abuse files will take place in Rochester, since the entire file is much smaller, and the computational abilities of the relevant agency make it better for us to do this match. We have a sample data tape in Rochester now, and are engaged in an ongoing process to verify our ability to read the data, make certain that all relevant variables are included, etc. This verification process should be complete by the end of June, 1991 if not sooner.

IV. "Intangible" Benefits

We cannot measure some benefits directly, but we can discuss their occurrence and magnitude. We wish to emphasize, however, that our benefit/cost analyses will clearly delineate those
benefits that we can measure directly vs. these "intangible" benefits. We will conduct benefit/cost studies both including and excluding these intangible benefits, and (as noted) emphasize the accounting of tangible governmental benefits as a particular item of interest in our cost benefit analyses.

"Consumer Surplus" Benefits

Some benefits accrue directly to the young mothers and their children, but do not create dollar flows. For example, if a mother’s or child’s health is improved by the intervention, Medicaid and/or the mother saves some medical care costs (which we measure directly), but the additional health also creates a benefit to the mother or child. These are real benefits, but we cannot measure them directly; rather, we must infer them using standard methods of economics. Similarly, the actual medical expenses occurring (even if reduced because of successful preventive measures) create benefits to the mother and child. The tools to do this are well defined (McKenzie and Pearce, 1986, Gramlich, 1979, Harberger, 1964). Basically, these methods estimate a consumer’s willingness to pay for some good (like a hamburger or a doctor visit), and then count as "consumer surplus" any amount that the consumer would have been willing to pay above and beyond the cost of providing that good.

"Compound-Event" Benefits

Another type of benefit occurs where we can measure the first of several steps in a chain of events that create a (later) measurable benefit. We call these "compound event" benefits. For example, we can measure (in the first two years of life) certain changes in cognitive function for the children in the treatment group. Other studies link such changes to schooling success, so we can "extrapolate" some of the changes in early cognitive function into schooling success. Next, we can use labor market studies to show the effects of schooling completion on earnings. These extra earnings (appropriately) discounted, constitute an "indirect" benefit of the intervention. Finally, those extra earnings generate extra income and sales taxes for governments (again, appropriately
discounted), that create a separate benefit for government. (Put differently, the private and government sectors share in the extra earnings; we cannot add the extra earnings and the extra taxes both. We can, however, show how the extra earnings divide between private and government accounts.)

Another "indirect" benefit occurs through established links in child abuse. According to some estimates, up to 80 percent of all abused children in turn become child abusers when they become parents. Thus, reduction in the number of children abused in a current generation also creates reductions in the number of children abused in future generations. Any medical expenses saved, and unmeasured but important benefits of reduced psychological trauma to abused children constitute future "indirect" benefits of the program.

**Child Development Outcomes.** In addition to the above-discussed program effects, we shall try to estimate the future cost savings associated with the facilitation of certain child development outcomes. Pregnant women who are visited by the nurse, for example, may have fewer low-birthweight newborns than women in the control group. Low-birthweight babies growing up in adverse circumstances are more likely to manifest developmental problems, including mild retardation, minimal brain damage, and hyperactivity -- costly conditions requiring treatment throughout the child's life. By raising the average birthweight in our nurse-visited groups, we may reduce later expenditures. Since such benefits occur in the future, and costs are incurred now, we must discount future benefits appropriately using measures of the social discount rate drawn from the literature.

The program also may be successful in reducing the number of infants who fall more than one standard deviation below the mean on the Fagan Infant Intelligence Test (Fagan et al, 1986). It may be possible to obtain data that will allow us to estimate costs associated with remediating developmental problems associated with low Fagan scores. These data can then be used to predict future cost-savings across treatment groups.
IV. Considerations in Estimation of Program Effects

The randomized controlled trial (RCT) design of this study means that we may, if we wish, simply use differences in averages among the treatment and control groups to estimate the effects of the intervention on the various outcomes we have described. These techniques are known as "analysis of variance," or ANOVA methods. While these methods provide straightforward and unbiased estimate of the program effects, they are not fully efficient; we can gain improved precision by using more powerful statistical techniques.

When we try to detect statistically significant program effects, the estimates of average outcomes in treatment and control groups that we must use will have some uncertainty within them. We can reduce this uncertainty by using other information we know about the mothers, the "covariates" that affect their behavior and outcomes. For example, if a new mother has been abused as a child, this increases the likelihood that she herself will abuse her current child. Thus, the analysis of child abuse within our study will estimate the effects of the treatment intervention on child abuse controlling for the presence or absence of previous abuse of the mother. These techniques are known as analysis of covariance, or ANOCOVA.

Some of the outcome measures we study have a "yes/no" characteristic. We will use the appropriate statistical methods in such events, e.g., logistic or probit regression.

V. Summary and Conclusions.

In the analysis of costs and benefits of the nurse-visitation program being studied experimentally in Memphis, TN, we will provide broadly based estimates of economic benefits and costs of the program, but we will also emphasize in our analysis the financial benefits and costs that fall on government programs, since decisions to undertake such programs may well depend importantly on net financial costs to governments. An important portion of the benefit/cost analysis data will derive from county records showing payments for Medicaid, AFDC, Food Stamps, etc. We
have constructed a rigorous method to verify that the data we obtain from these sources matches the persons enrolled in our study. We will also gather considerable information directly from the participants in the study about their use of a number of community services, forming another important part of the cost/benefit data base.

In analyzing the program costs, we have devised several alternative methods to estimate data, mostly revolving around the problem that some of our program costs are experimental, and would not occur in a routine operational program. We will also make special effort to estimate incremental program costs for participants of various types (e.g., different psycho-social risk groups) in order to support sub-group analyses of incremental benefits and costs. These data come from records kept by our nurse visitation team showing the time they spend associated with various participants.

Our goal, of course, is to estimate the incremental benefits and costs associated with the nurse home visitation program, for the target population as a whole and, where possible, for subgroups that can be identified ex ante. This latter analysis should assist in focusing attention on populations most likely to benefit from the program, or those for whom the cost/benefit calculation is relatively unfavorable or favorable.
BIBLIOGRAPHY


Figure 1

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<tbody>
<tr>
<td>Govt.:</td>
<td>Govt:</td>
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<tr>
<td>Child spacing</td>
<td>less 2nd generation</td>
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<td></td>
<td>child abuse costs;</td>
</tr>
<tr>
<td>Private:</td>
<td>increased future taxes</td>
</tr>
<tr>
<td>Improved health</td>
<td>Private:</td>
</tr>
<tr>
<td></td>
<td>increased self esteem</td>
</tr>
</tbody>
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