REPORTS

Integrating Health Services into an MCH–FP Program in Matlab, Bangladesh: An Analytical Update

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This is a follow-up to a 1984 study that analyzed the relationship between areal variation in the contraceptive prevalence time series and in the intensity of maternal and child health (MCH) services of the Matlab Family Planning Health Services Project. Results based on 69 months of observation suggested that the addition of MCH components to a program with basic MCH and comprehensive family planning services had no incremental impact on family planning efficacy. However, basic MCH services, involving clinical back-up to family planning and child care since the beginning of the program in Matlab, may have contributed to clients' faith in the clinic staff and the overall efficacy of the Matlab program.

In the 18 months that followed the cut-off date for this analysis, contraceptive prevalence increased markedly in the study areas. The present analysis repeats the earlier one for the extended time series to determine if the intensification of health services in Matlab contributed to this secondary increase in prevalence, and to ascertain whether the MCH service regimes have long-run differential impacts.

Results for the 87-month time series are similar to those of the previous analysis, suggesting that the introduction of additional MCH inputs in the Matlab service area over the 1982–83 period had no incremental impact on the contraceptive prevalence rate time trend.

The question of whether to integrate population and health programs or to maintain them as separate categorical programs has been much debated in the health and population policy literature. The debate focuses on the hypothesis that population programs are more effective when integrated with health or development programs than when administered separately.[1] The resolution of this debate has been hampered by both a lack of clarity about substantive issues to be researched and by the absence of situations in which careful prospective trials of alternative service approaches can be conducted. In 1984, Phillips et al. reviewed issues in the integration controversy, prospects for resolving it, and evidence from a project in Matlab, Bangladesh that permits analysis of one aspect of the integration hypothesis: whether adding maternal and child health (MCH) components to a functioning family planning program with limited MCH services has an incremental impact on family planning efficacy.[2] The results, based on 69 months of observation, failed to produce evidence of a positive effect of adding MCH components. The early success of the Matlab project and the absence of evidence showing a subsequent impact of MCH services, therefore, suggests that a family planning program with limited MCH components, if carefully implemented, will be as effective as a package with comprehensive MCH services.

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The policy significance of the Matlab findings is enhanced by the unusually rich data from the Family Planning Health Services Project (FPHSP) in Matlab on program inputs and outcomes. The FPHSP design incorporates areal variance in program inputs that are relevant to researching the integration question. Moreover, it is appropriate to hypothesize that the rapidly changing contraceptive use dynamics in Matlab in recent years covary with the type of services provided to Matlab villagers.

Opportunities for researching the integration issue that are comparable to the FPHSP are rare. Experiments involving the uncontaminated observation of integrated versus single-purpose service systems are usually impossible to carry out, because national integrated programs have long been actively functioning. Situations such as Matlab, where national programs still have no pronounced effects, typically lack the requisite data and research climate required for testing the integration hypothesis.[3] This paper updates the 1984 analysis, which modeled trends in contraceptive prevalence from the Matlab FPHSP as a function of incremental MCH. In the 18 months that followed the cut-off date for the original analysis, contraceptive prevalence increased markedly in the study areas. The present analysis repeats the earlier one for the extended time series to determine if the secondary increase in family planning prevalence is explained by the intensification of health services in Matlab. The objective is to test whether findings based on the 1983 data are robust to the changes that took place in Matlab over the subsequent 18 months.

The Rationale for the Reanalysis

In October 1977 the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) launched the FPHSP to test the hypothesis that family planning services, if implemented carefully, could produce widespread use of contraceptives in a rural traditional society, and thereby reduce fertility. Research on FPHSP impact has shown that fertility effects were pronounced and have been sustained with time.[4]

A possible explanation for the success of the FPHSP is its reliance on integrated services, a hypothesis that cannot be evaluated from the FPHSP alone, since limited MCH services and the provision of paramedical care for children were incorporated in the design from the beginning of the study. Nevertheless, findings from a previous study in Matlab and analysis of FPHSP data suggest that minimal health care back-up to family planning services contributes to family planning success in that basic MCH services established from the outset of the FPHSP may have lent credibility to workers and their program over time.[5] Subsequent development of MCH services over the 1980 to 1983 period was introduced in stages, however, with intensification of MCH interventions concentrated in half of the treatment area. The observed trends in contraceptive prevalence in the service areas were modeled as a function of areal variation in MCH intensity. Details of the project design and the analytical framework for the analysis appear in the 1984 study.[6]

Results of the 69-month time series analysis suggest that the operational impact of intensifying MCH services can detract from family planning, particularly if a new MCH component is added to a program without carefully considering how to maintain the intensity of existing MCH or family planning services. Results also indicate, however, that one MCH strategy, measured by the case load of child care, may have contributed to family planning efficacy, while other MCH components had no significant incremental impact.

These findings, however, were subject to qualification on two grounds. First the authors acknowledged that the effect of intensified MCH on contraceptive prevalence could arise as a long-term effect, not readily detected within the time period available for the analysis. Reanalysis of the data is appropriate because, during the period following the cut-off (June 1983) for the analysis, Matlab experienced a sustained increase in contraceptive use to levels unprecedented in the history of that locality.[7] By the end of 1984, contraceptive prevalence had reached nearly 46 percent of the currently married women of reproductive age. This represents an increase of over 10 percentage points during the 18 months that elapsed between the cut-off date of the 1984 analysis and the present analysis.[8] If the increase in prevalence over the 18 months following the 1984 study was relatively pronounced in areas in which MCH services were intensified, findings from the earlier study would be subject to qualification and revision.

Secondly, the robustness of the Matlab experiment for assessing the impact of MCH intensification differs for type of MCH service. Services implemented in all areas simultaneously are more difficult to evaluate than services implemented in only some of the areas. Thus, the effects of the basic MCH services on family planning are more difficult to estimate than other MCH interventions because all four blocks in the Matlab treatment area have, at minimum, limited services: clinical back-up and care, oral rehydration therapy (ORT), tetanus immunization for pregnant women, and continuous household visitation by trained community health workers. Consequently, there is no variance within the treatment areas with respect to services included in the basic MCH package. The 1984 Matlab analysis is based on the four blocks of the treatment area, all of which received limited MCH services and two of which received intensive services. In the context of these analytical constraints the effect of incremental "basic" MCH interventions, such as oral rehydration and tetanus immunization, can only be analyzed as the "before versus after" impact of a given new intervention on the time trend in contraceptive use. Such analyses are statistically weak, since secular time trends caused by events unrelated to the variables under investigation can bias results.[9] The parameters of interrupted time series models are thus sensitive to the type of model selected, and findings from such studies are often the subject of debate.[10] Although this limitation of the analysis does not apply to the post-1979 incremental MCH interventions, because their limited introduction in intensive areas can be assumed to control for external effects, the prolonged post-1983 increase in prevalence introduces the possibility that long-term effects of MCH services, which were not yet apparent in 1983, may have arisen in the interim.

It is appropriate, therefore, to reanalyze the expanded Matlab contraceptive prevalence time series to ascertain whether previous results are robust to the addition of 18 months of observation, a period in which the dependent variable for the analysis, contraceptive prevalence, increased dramatically in Matlab treatment areas while service interventions remained unchanged.

The Model

The 1984 analysis and the present study are guided by a common statistical model. The model assumes that the effects of MCH interventions on prevalence become manifest as disjunctures from an underlying time trend in contraceptive prevalence for Matlab as a whole. This hypothesis is conceptually different from one positing that the overall trend in the contraceptive prevalence rate can be explained by the MCH interventions. In this study, the overall trend is taken as a given, while deviations from the trend are the focus of analysis. Estimation proceeds in two steps: the first step entails estimating an underlying time series model for Matlab treatment area contraceptive prevalence trends since October 1977. The second step entails deriving net disjunctures from this underlying model and estimating the effect on these disjunctures associated with a given intervention, while controlling for the effects of the other interventions.

Although this estimation procedure is the same as that used in the 1984 analysis, one important difference in the first step of the methodology should be noted. The shape of the underlying time trend of contraceptive prevalence rates was altered substantially by the 18 additional months of observation (see Figure 1). This necessitated the inclusion of two turning points in the functional form used to estimate this time trend, rather than one as in the earlier analysis. Details of the estimation procedure are presented in the Appendix.

Results

The time trend in contraceptive prevalence for the four blocks in Matlab is shown in Figure 1 together with the timing of the MCH interventions over the 1978 to 1983 period.[11] The figure shows for each block the pronounced rise in prevalence that accompanied the initial year of the FPHSP, the plateau in prevalence over the 1979 to 1982 period, and a sustained increase in contraceptive prevalence over the entire 1983 to 1984 period. The dynamics of these trends are not considered in detail here. For the purpose of the present analysis it is sufficient to note that the differences in the prevalence rates between blocks diminished over the 1983 to 1984 period, and increases were observed in all blocks, including those in which less intensive MCH services were in place. By the end of calendar year 1984, the relatively low prevalence rate that had prevailed prior to 1982 in Block B, a limited MCH area, had converged with the rates in Blocks A and C where MCH services had been intensified over the 1982–83 period. Block D, also a limited MCH area, experienced the most pronounced increase in prevalence over the 1982 to 1984 period, to levels approaching 50 percent. Thus the time trends reported in Figure 1 are inconsistent with the hypothesis that intensification of MCH explains Matlab's sustained and dramatic increase in prevalence over the 1982 to 1984 period.

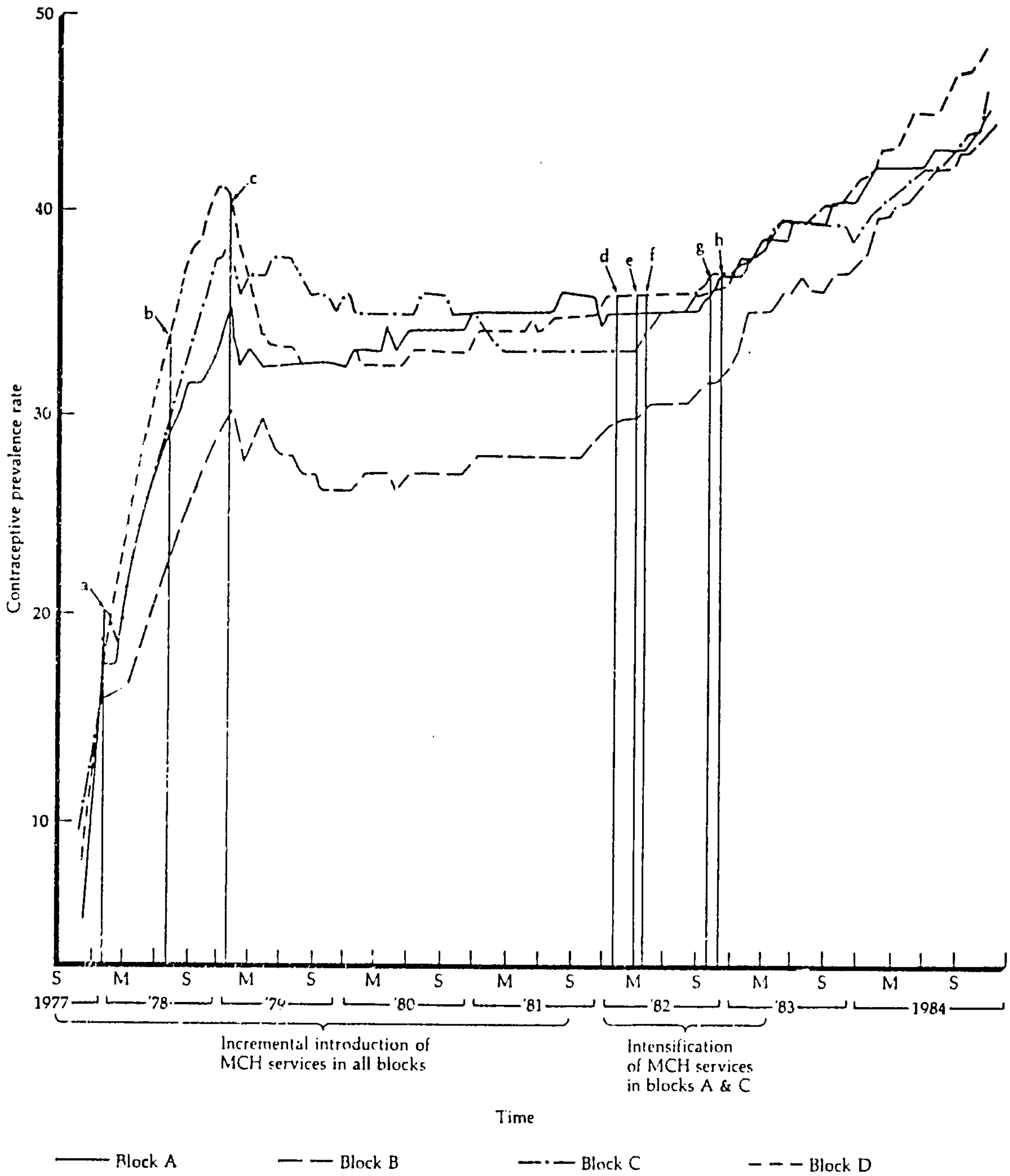
The time series regression results are consistent with the conclusions drawn from Figure 1. Parameters and statistical tests for the analysis are reported in Table 1. Columns 1 and 2 in Table 1 report coefficients and t-statistics for the 1984 analysis of 69 months of data.[12] Columns 3 and 4 present the results of the present analysis using 87 months of data and the double spline technique.[13]

The addition of 18 months to the time series did not change substantive results or the implications of findings for policy. Coefficients that are significant or insignificant in the 69-month analysis remain so in the 87-month analysis, and the sign and magnitude of significant variables are consistent across the two studies. The two oral rehydration therapy interventions, *labon-gur* (home solution) and prepared packets, implemented in January 1979, continue to have strong negative incremental impacts on contraceptive prevalence, although their effects appear to have diminished slightly over time. This enduring consequence of the oral rehydration interventions is discussed more fully in the next section.

The child care caseload variable also retains its positive and significant coefficient in the 87-month analysis. This result suggests that treatment of increased numbers of children at the family welfare centers contributes to contraceptive prevalence. This does not necessarily imply a link between child illness and contraceptive use; rather, it indicates the importance of a well integrated system of referral at the household level and treatment at the clinic level in a successfully operated project.

The lack of significance of the home IUD insertion program begun in April 1982 is not surprising. As discussed in the earlier paper, this program resulted in an increase in IUD prevalence and a concomitant decline in the prevalence of other methods, thus altering the mix of methods used but not overall prevalence.[14] This is still an important result, both from the point of view of fertility

Figure 1 Time trend in contraceptive prevalence in four service areas of the Family Planning Health Service Project



Note: All blocks had family planning services; Blocks A and C also had intensive maternal/child health care services, and Blocks B and D had limited maternal/child health care services. Services are represented as follows: a = IUD insertion; b = tetanus vaccine to pregnant women; c = oral rehydration therapy; d = tetanus vaccine to all women in Blocks A and C; e = measles vaccine in Blocks A and C; f = IUD home insertion; g = antenatal care in Blocks A and C; h = training of traditional birth attendants in Blocks A and C. On the X-axis (Time), M is March and S is September.
*Family planning services were introduced in October 1977.

regulation and individual well-being, as it suggests that couples were able to select a more effective and perhaps otherwise preferred method of contraception.

The hypothesis that the intensification of MCH services in 1982 had a positive incremental impact on the contraceptive prevalence rate is not supported by the results in Table 1. The measles/tetanus vaccine variable and the antenatal care/TBA training variable do not have significant coefficients. These interventions are certainly important in achieving other objectives, but they do not seem to be instrumental in increasing the contraceptive prevalence rate in the Matlab population.

Table 1 A comparison of first-order generalized least squares (GLS) regressions of contraceptive prevalence on maternal/child health (MCH) and family planning service interventions in Matlab for 69-month versus 87-month time series analyses

	Generalized least squares regressions			
	69-month analysis[a]		87-month analysis[b]	
Variable	Coefficient (in 100s)	*t*	Coefficient (in 100s)	*t*
Family planning				
Home IUD insertion	+0.67	+1.33	−0.09	−0.20
MCH services				
Tetanus vaccine (pregnant women)[c]	+0.01	+0.85	−0.01	−1.21
Measles + tetanus vaccine (all women)[d]	+0.05	+0.08	−0.95	−1.54
Oral rehydration therapy				
Packet	−3.52	−5.04*	−2.37	−4.25*
Labon-gur	−7.63	−11.17*	−6.52	−11.12*
Antenatal care, TBA[e] training	+0.86	+1.25	−0.35	−0.57
Child care caseload[f]	+1.23	+3.81*	+1.85	+4.62*
Maternal care and family planning caseload[f]	−0.85	−1.15	−0.65	−1.14
Intercept	+0.80	na	+0.48	na
Summary statistics				
Lag coefficient	+81.29	—	+83.79	—
Observations	276	—	344	—
R^2	0.39	—	0.29	—
F	21.46	(df = 8/263)*	17.03	(df = 8/335)*
Standard error (est.)	1.92	—	0.93	—
D[g]	0.22	—	0.26	—
Box-Pierce X (OLS)	243.48	(df = 20)*	491.98	(df = 20)*
Box-Pierce X (GLS)	24.66	(df = 20)	22.06	(df = 20)

Note: df = degrees of freedom; na = not available.
* $p < .001$ (two tail).
[a] Revised results of 1984 analysis. [b] The cut-off date is December 31, 1984. [c] Cumulative percentage immunized. [d] Owing to the concomitant introduction of tetanus and measles immunization programs, the two variables are collapsed into a single indicator for whether or not either was introduced. [e] Traditional birth attendant. [f] Cumulative caseload in thousands. [g] Durban-Watson statistic for the ordinary least squares.

Implications

The negative effect of oral rehydration interventions has been explained by Phillips et al. as the consequence of introducing a categorical MCH intervention, under a project designed as a separate program with special purposes and priorities that may have appeared to the workers and clients in Matlab to differ from the priorities of the more general MCH regimen of the FPHSP service system.[15] Oral rehydration was introduced as a field trial designed to test the relative efficacy of two alternative approaches, the prepared packet versus the home solution (*labon-gur*) approach. Although the trial used the field staff, supervisors, and management system of the FPHSP, the priorities and work assignments to staff emphasized technical requirements of the field trial rather than stressing the importance of maintaining continuity in the FPHSP package of services.[16] In this sense, the negative ORT coefficients demonstrate the effects of integrating technical components under a "disintegrated" mode of priority setting and field orientation of workers.

It is nevertheless a bit surprising that the significant negative effect of the oral rehydration trial persists despite the long period in which the effects of a temporary disruption in services could be mitigated. These negative effects contrast with the absence of any such effects from the introduction of immunization and other MCH services in 1982. Building on the early FPHSP experience with the incremental development of services, the subsequent integration of MCH services into the FPHSP regimen had no detrimental effects on family planning.

The fact that the impact of the FPHSP could be so sensitive to the administrative climate in Matlab is instructive in two respects. The first, noted in the 1984 analysis, concerns strategies for integration. The development of a complex service program requires administrative support at each stage to insure that the addition of new services is accompanied by careful strategizing about how to maintain the intensity and quality of existing services. The second implication, often overlooked in theoretical work on the determinants of fertility regulation behavior, concerns the overall importance of program effort to contraceptive practice. The possibility that the introduction of an MCH service, with obvious benefits to society, could have negative effects on the efficacy of a well organized and effective family planning delivery system, attests to the importance of the quality and intensity of services as a key determinant of family planning behavior. In settings such as Matlab, where the motivation to practice contraception is weak, services must be delivered by dependable and committed workers without interruption. The enrichment of MCH and family planning programs to include a wide array of health and family planning services is a goal with intrinsic appeal to policymakers. In pursuing this goal, however, careful attention to maintaining the quality of existing services should be a critical consideration in the introduction of new services.

Finally, the consistency of the present findings with earlier results suggests that the intensification of MCH services in the FPHSP did not contribute incrementally to the dramatic rise in prevalence in Matlab over the 1983 to 1984 period. Other factors, unexplained in the present analysis, must account for the recent secondary rise in Matlab contraceptive prevalence.

Appendix

The first step is a spline regression given by:

$$\lambda(t) = \beta_0 + \beta_1 t + \beta_2 t' + \beta_3 t'' \qquad (1)$$

where

t: defines ordinal months since the beginning of the projec. in October, 1977;

t': defines ordinal time from a disjuncture in the time series in which $t' = 0$ until a defined disjuncture in the dependent variable time trend is reached, t_d, at which point $t_d = 1$, $t_{d+1} = 2$ etc., until t_{69-d}, the cut off date for the study; and

t'': defines ordinal time from a second disjuncture in the time series of the dependent variable in which $t'' = 0 \ldots, t_e = 1, t_{e+1} = 2$, etc.

Months t_d and t_e are chosen by selecting the time points that maximize explained variance in the estimation of the parameters of equation (1) using ordinary least squares regression analysis (OLS). The difference between equation (1) and the Phillips et al. model is the second spline, t'', and its estimated parameter, β_3, which were unnecessary for the 69-month period.[17] In the period after mid-1983, however, a single spline specification was increasingly unrepresentative of the time trend in prevalence in Matlab. Thus, $\lambda(t)$ was modified with the parameter β_3 and the second disjuncture, t'', was added to better fit the data available for the analysis.

In the second step of the analysis the time function in equation (1) is used to linearize a multiple time series regression model. This is achieved by using as the dependent variable in step two, regression residuals from step one representing the difference between observed and estimated patterns in contraceptive prevalence. This second model is given by:

$$P_t - \lambda(t) = \sum_{l=1}^{L}\phi_l t_{t-l} + \sum_{j=1}^{J}\gamma_j X_j + \sum_{k=1}^{2}\delta_k Z_k \qquad (2)$$

where

P_t: is the observed prevalence rate at time t;

$\lambda(t)$: is the estimated prevalence rate at time t;

X: is a $J \times 1$ vector of service characteristics for the J interventions, which are measured dichotomously (0,1), and γ_j is a corresponding vector of coefficients;

Z: is a 2×1 vector of cumulative caseload variables, and δ_k is a corresponding vector of coefficients; and

t_{t-l}: is a lag term used to adjust for autocorrelation and ϕ_l is its corresponding coefficient. L is the minimum requisite number of lags for adjusting for autocorrelation.

The unknown coefficients ($\gamma_j, \delta_k, \phi_l$) are to be estimated using generalized least squares regression analysis (GLS) in which L lag coefficients are used in the second stage to adjust for the effects of autocorrelation. One lag ($L = 1$) was found to be sufficient.

References and Notes

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1 For a review of policy issues in the integration debate, see R. Simmons and J.F. Phillips, "The integration of family planning with health and development," in *Determinants of Family Planning Effectiveness*, edited by R. Lapham and G. Simmons (Washington, DC: National Academy of Sciences, 1985).

2 J.F. Phillips, R. Simmons, J. Chakraborty, and A.I. Chowdhury, "Integrating health services into an MCH-FP program: Lessons from Matlab, Bangladesh," *Studies in Family Planning* 15, no. 4 (July/August 1984): 153–161.

3 The FPHSP design is discussed in S. Bhatia, W.H. Mosley, A.S.G. Faruque, and S. Chakraborty, "The Matlab Family Planning Health Services Project," *Studies in Family Planning* 11, no. 6 (June 1980): 202–212, and J.F. Phillips, R. Simmons, J. Chakraborty, and A.I. Chowdhury, "Integrating health services into an MCH-FP program: Lessons from Matlab, Bangladesh," *Studies in Family Planning* 15, no. 4 (July/August 1984): 153–161.

4 The demographic impact of the FPHSP is discussed in J.F. Phillips, W. Stinson, S. Bhatia, M. Rahman, and J. Chakraborty, "The demographic impact of the Family Planning Health Services Project in Matlab, Bangladesh," *Studies in Family Planning* 13, no. 5 (May 1982): 131–140. Subsequent analyses have shown that the impact has been sustained with time; see A.I. Chowdhury, J.F. Phillips, and J. Chakraborty, "Recent trends in contraceptive use prevalence and fertility in Matlab: Possible implications of recent demographic dynamics for policy," paper prepared for presentation at the Second Annual Conference of the Indian Society for Medical Statistics, 23–24 November 1984, Lucknow, India.

5 An antecedent Matlab study, the Contraceptive Distribution Project (CDP), tested whether household distribution of oral contraceptives and condoms with no clinical back-up, client education, or systematic follow-up would produce significant demographic effects. Although results were initially promising, the CDP failed to have a long-term fertility impact; see D.H. Huber and A.R. Khan, "Contraceptive distribution in Bangladesh villages: The initial impact," *Studies in Family Planning* 10, no. 8/9 (August/September 1979): 246–253. and W.S. Stinson, J.F. Phillips, M. Rahman, and J.

Chakraborty, "The demographic impact of the Contraceptive Distribution Project in Matlab, Bangladesh," *Studies in Family Planning* 13, no. 5 (May 1982): 141–148. Analysts concluded that rigorous paramedical back-up of users, a wider range of methods, better follow-up and supervision, and basic maternal-child health (MCH) services were required. The FPHSP employed a new cadre of workers, with better training and field strategies that were informed by the CDP experience; see M. Rahman, W.H. Mosley, A.R. Khan, A.I. Chowdhury, and J. Chakraborty, "Contraceptive distribution in Bangladesh: Some lessons learned," *Studies in Family Planning* 11, no. 6 (June 1980): 191–201. The original design of the FPHSP called for intensive MCH in all blocks (see Bhatia et al., 1980, cited in note 2), but because of staff shortages and resource constraints, MCH expansion after 1979 was limited to two of four blocks until 1985 (see Phillips et al., 1984, cited in note 2). Thus, the FPHSP was MCH-oriented from the outset, but with a primary focus on family planning and priorities aimed at establishing comprehensive family planning before multiple MCH services were introduced. The gradual introduction insured that, at each stage, services were understood by workers and effectively managed in the field before a new component was added. It is this strategy of phasing in services by block in stages over time that gives rise to the areal and temporal variation in inputs that is modeled in the Phillips et al. (1984, cited in note 2) analysis.

6 Phillips et al., cited in note 2.

7 J.F. Phillips, M.A. Koenig, and J. Chakraborty, "The Matlab Family Planning Health Service Project impact on family planning, fertility, and child survival: A report of key findings and their policy implications," unpublished manuscript (1986).

8 Phillips et al., cited in note 7.

9 Although "before versus after" experimental designs provide a weaker basis for inference than alternative treatment designs (see D.T. Campbell and J.C. Stanley, *Experimental and Quasi-Experimental Designs for Research* [Chicago: Rand McNally College Publishing Company, 1963]), there is no alternative to this type of analysis since inference derives from situations in which experimentation is impossible; see, for example, R.R. Rindfuss, J.S. Reed, and C. St. John, "A fertility reaction to a historical event: Southern white birthrates and the 1954 desegregation ruling," *Science* 201, no. 4351 (July 1978): 178–180, and J. Knodel, T. Bennett, and S. Panyadilok, "Do free pills make a difference: Thailand's experience," *International Family Planning Perspectives* 10, no. 3 (September 1984): 93–97.

10 For an example of this type of controversy, see T.D. Hogan, "Evaluating the demographic impact of societal events through intervention analysis: The Brown vs. Board of Education decision," *Demography* 21, no. 4 (November 1984): 673–677, and the reply by R.R. Rindfuss, M.K. Salemi, J.S. Reed, and C. St. John, "Intervention analysis: The Supreme Court and Hogan," *Demography* 21, no. 4 (November 1984): 679–682.

11 The timing of interventions (b) and (e) in Figure 1 is slightly different than in the paper by Phillips et al. (1984, cited in note 2). In the previous paper, the date at which training for the interventions began was used, whereas in the present paper the date of implementation is used. The latter approach is consistent with the data used in the current statistical analysis.

12 In the data used for the Phillips et al. (1984, cited in note 2) analysis, the cumulative child care caseload was miscoded in month 28 of Block D as 970 instead of 97. This error produced an upwardly biased coefficient for cumulative child care and the intercept, but had no other effects. The results reported in Table 1 of this paper have been corrected for this data error. The re-estimation of the 69-month analysis also employed a modified software package that adjusted the calculation of the denominators in variance covariance matrices to correct for the degrees of freedom implied by the number of observations at each time point. These corrections to the data matrix and improvements in software did not alter the substantive results of the study, however. For details of the estimation procedures utilized, see D. Leon and J.F. Phillips, "Analytical programs for multivariate operations research on limited capacity computer systems," unpublished mimeographed report (Dhaka: International Centre for Diarrhoeal Disease Research, 1983) and D. Leon, "A personal computer package for time series analysis: TSA, TSA1, TSA2, and TSA3," unpublished manuscript.

13 For information on spline techniques, see J.H. Ahlberg, E.N. Nilson, and J.L. Walsh, *The Theory of Splines and Their Application* (New York: Academic Press, 1967), or T.N.E. Greville, *Theory and Applications of Spline Functions* (New York: Academic Press, 1969).

14 Phillips et al., cited in note 2.

15 Phillips et al., cited in note 2.

16 Preliminary FPHSP contraceptive prevalence reports for the first quarter of 1985 show a similar pattern following the introduction of a new cholera vaccine in Matlab. Because the vaccine was introduced as a trial, with vigorous field requirements and considerable demands on staff for community organizational work, contraceptive services were de-emphasized and prevalence declined in all four of the Matlab service blocks. The vaccine trial, like the oral rehydration study, was conducted by FPHSP staff.

17 Phillips et al., cited in note 2.