The Fertility Impact of Achieving Universal Health Coverage in an Impoverished Rural Region of Northern Ghana

Background

For the past four decades, Ghana has embraced primary wealth care policies inspired by the 1978 Alma Ata accord (World Health Organization 1978). In response to evidence that the Alma Ata "health for all" agenda was not being achieved as planned, the Ministry of Health commissioned an experimental trial of the Navrongo Health Research Centre (NHRC) to develop and test means of implementing community-based primary health care (Adongo et al. 1997; Binka, Nazzar, & Phillips 1995; Nazzar, Adongo, Binka, Phillips, & Debpuur 1995). When early results of this trial were promising (Binka et al. 2007), and replication research demonstrated replicability of strategies and results (Awoonor-Williams et al. 2004), the Ghana Health Service (GHS) adopted a scaling up policy known as Community-based Health Planning and Services (CHPS) in 1999 that was implemented in 2000 and continues to the present (Ghana Health Service 1999). CHPS deploys certified community nurses to community locations, organizes community support for their work, and procures essential technology, supplies, and equipment to support service delivery work. Each CHPS nurse is provided with at 18 months of training in primary health care services, with an additional six months of practical internship training (Ghana Health Service 2005). In the original CHPS operational model, nurses were supported by community volunteers who have had varying degrees of training and responsibilities, but are usually assigned health promotional tasks that backstop curative and preventive health service activities (Wells-Pence et al. 2007). All CHPS workers are trained and equipped to provide family planning services that include the provision of oral contraception, injectable methods, condoms. Some midwives provide sub-dermal contraception in CHPS or other locations. All workers are trained in contraceptive counselling and referral to paramedics based in hospitals and sub-district (Ghana Health Service 2017).

Monitoring of the Navrongo project showed that posting nurses to community locations reduced childhood mortality by over half in only three years and reduced fertility by 15 percent in five years, a change that was equivalent to a full birth reduction in the total fertility rate (Phillips, Bawah, and Binka 2006). This finding was successfully replicated in a series of small scale implementation research projects (Awoonor-Williams, Sory, Nyonator, et al. 2013; Sory, Jones, Nyonator, & Phillips 2003). However, fertility effects of community-based care were minimal where services relied solely upon clinical or household service outreach by CHPS nurses. Fertility effects only arose if community engagement strategies were rigorously implemented in ways that supplemented nursing services with organized outreach to men, community gatherings for family planning promotion, and other activities that addressed social constraints to the reproductive autonomy of women (Phillips et al. 2012; Bawah et al. 1999).

A variety of service delivery, manpower, communication, logistics, resource management, and leadership bottlenecks constrained the pace of CHPS scale up in the first decade following its founding (Krumholz, Stone, Dalaba, Phillips, & Adongo 2014; Nyonator, Awoonor-Williams, & Phillips 2011). In 2009, the Ministry of Health responded to this evidence by convening a panel of experts to clarify operational factors that explained why CHPS scale-up was proceeding so slowly (Binka et al. 2009). Recommendations were assembled into a set of posited actions that could be taken by district managers to accelerate CHPS scale-up, such as training to mitigate district management reluctance to proceed with CHPS implementation, training in community engagement, addressing the revenue requirements of constructing health posts and other systems interventions. CHPS implementation impact was immediate and pronounced, with CHPS population coverage increasing a double rates observed in comparison areas.

The problem. Commitment to expanding and improving CHPS has gained impetus from global commitment to achieving "Universal Health Coverage". Policy pronouncements, international conferences, and influential commentary have focused on 11 component themes, one of which posits that access to affordable family planning services is an essential outcome of UHC. Thus, policy deliberations assume that achieving UHC is tantamount to providing universal family planning care (UFPC). This important assumption is untested. This analysis responds to this evidence gap by assessing the reproductive preference, family planning, and fertility impact of GEHIP.

The socio-economic and demographic context

Baseline survey results portrayed the GEHIP study setting as a typically poor and rural. As high as 87% of the 5511 respondents interviewed, live in rural settlements while 13% live in urban settlements as defined by the Ghana Statistical Service. The age structure of the respondents reveals a typical young and potentially fertile childbearing population. More than half (52.5%) of the respondents are younger than 30 years old. As high as 60.8% of the respondents have not had formal education while 66.2% are married. The total fertility in this setting is 5.4 and the infant mortality rate and child mortality rate is 61 and 35 per 1000 respectively.

Methodology:

GEHIP was a plausibility trial of health systems strengthening that was conducted in the Upper East Region (UER) over the 2010 to 2016 period GEHIP. CHPS reform strategjes were associated with a five-fold increase in the population served by community-based primary health care coverage. A sample survey, conducted in 66 clusters of districts exposed and unexposed to interventions permitted a difference-in-difference assessment of the hypothesis that rapid achievement of UHC will achieve significant improvements in reproductive health and reduction in fertility. Endline data collection utilized the baseline clusters, an arrangement that enhances the statistical efficiency of difference-in-difference analysis. However, no attempt was made to seek baseline households.

Estimating average treatment effects. , Although GEHIP uses conventional sampling procedures to gauge treatment and comparison differences, comparison could be affected by omitted variable bias if areas that are exposed to project activities differ systematically from those which are not due to unobserved characteristics. Accordingly, the project constructed an estimator of program effect that takes into account the time-invariant unobserved heterogeneity between intervention and comparison localities. By using repeated household survey data and estimating "differences-in-differences," (DiD) the project could compare outcomes before and after interventions at any point in time following the possible onset of treatment effects (Heckman 1974). As the protocol specifies, average treatment effects (ATE) are estimated as follows for indicators of interest:

$$ATE = E(Y_{Mt'} - Y_{Mt}) - E(Y_{Ct'} - Y_{Ct}) \tag{1}$$

In this model, **Y** describes a health outcome such as the under-5 mortality rate, the subscript **t** refers to measurements of health outcomes at baseline, **t'** refers to measurements of health outcomes at the end of the point of observation, **M** indexes GEHIP exposed sample cluster areas and **C** indexes comparison sample cluster areas.

At baseline, the unmet need for contraception in this study setting was as high as 36 percent for spacing and 19 percent for stopping. Unmet need continues to remain high. Results of the calculation of 1) for contraceptive use show that GEHIP exposure was associated with modest but statistically significant increases in contraceptive use. However, achieving UHC has been associated with a significant *increase* in unmet need.

The hazard regression model.

While the Heckman formula is widely applied, it has limitations for health systems research that require multivariate extension (Heckman and Hotz 1989). Variation in Y at various levels of the system are potentially confounding and are not addressed by (1). Moreover, the ATE estimate is potentially confounded by social determinants of health that covary with systems factors in ways that are subject to adjustment with multivariate methods (Bertrand, Duflo, and Mullainathan 2004). Thus, a regression extension of the Heckman procedure is used by GEHIP for evaluating fertility effects of the program. A "multi-level discrete time spline hazard model analysis" is used for estimating the role of health systems as factors that affect fertility. The age conditional hazard of birth is given by a discrete-time spline function of the form:

$$\Phi(a, p) \ = \ \phi_0 \ + \ \phi_1 a_i \ + \ \phi_2 a_m^2 + \sum_{j=1}^{J} \ \phi_{j+2}\,(a_i - a_p)^2 D_j \ + \ \phi_{J+3}\,(p_m) \qquad 2)$$

where,

a_i is exact age in a fertility function, $\Phi(a, p)$ that defines the exact age of individual i and p is a point of inflection for the ith inflection point, over P points of inflection for a "plateau" effect of age on fertility P (defining the number of inflection points where the plateau effect is operative) and peak fertility age effect D capturing the role of age whereby;

P_p = 1 if $a_m \geq a_p$,
P_p = 0 if $a_m < a_p$ and
D_i defines the age effect for individual mother m.

Since (1) defines P+1 curvilinear segments of the fertile ages, quadratic terms for each segment are employed. The vector of coefficients, **ϕ,** are unknown parameters for the effects of age whereby the term $\phi_j\,(a_m - a_p)^2 D_j$ permits expansion of the model to accommodate P points of inflection in the function. The number of knots and corresponding age points of inflection for unknown P points of inflection and ages at each inflection are determined by maximum likelihood.

An expansion of (1) to permit analysis of covariate effects is given by the expansion of (1), as follows:

$$\text{logit } q = \Phi(a, p) \ + \ \sum_{k=1}^{K}\beta_k X_{ikA} + + \sum_{l=1}^{L}\gamma_l X_{ilB} + \sum_{j=1}^{3}\delta_j z_j + \sum_{m=1}^{M}\eta_m u_m + \sum_{j=1}^{3}\sum_{k=1}^{K}\varsigma_{jk}(X_{ijkA}\cdot z_j) +$$
$$\sum_{j=1}^{3}\sum_{l=1}^{L}\theta_{jk}(X_{ikB}\cdot z_j) + \sum_{j=1}^{3}\sum_{m=1}^{M}\xi_{j_k}(z_j\ u_m) \ + \ \sum_{j=1}^{3}\sum_{m=1}^{M}\mu_{jk}(X_{ijkA}\ u_m) \ + \ \sum_{j=1}^{3}\sum_{l=1}^{L}\mu_{jk}(X_{ijlB}\ u_l) \qquad (3)$$

Where

q is the monthly odds of parity progression, as expressed in survey respondent birth histories;

$\Phi(a, p)$ defines elements of the fertility function (2) for the underlying odds of parity progression among individuals of a given age (a) and parity (p),

X_{kA} the kth principal component score among K estimated scores for indices of service readiness for the nearest CHPS implementation zone relative to the index residence i;

z_j is the linear distance of household *i* to the nearest facility of type j, where j defines district hospitals (j=1), Sub-District Health Centre (j=2) and CHPS facility (j=3),

u_k is the kth individual background characteristic among K variables defining years of maternal educational attainment, years of spousal educational attainment, a principal component index of relative household economic status, and other such indicators of maternal or household characteristics.

Unknown parameters, estimated by generalized maximum likelihood, are

$\beta_{i\,j}$ the effect of clinical readiness of index k relative to the exposed household *i* for facility of type *j*,

γ_j an adjustment for the remoteness of household *i* relative to facility of type *j* ;

ς_{jk} the nine-month lagged nuisance parameter adjusting for the interaction of maternal and household characteristic u_l among L such characteristics with remoteness, testing the proposition that adverse effects of poverty and low educational attainment are exacerbated by household remoteness.

ξ_{jk} is the joint effect of x_j among individuals with background social covariate of parity progression u_k among K such covariates; μ_{jk} is the joint effect of exposure to the clinical readiness of facility type *j* among individuals with background characteristic u_k among K such covariates, testing the proposition that poor service quality differentially impacts on the poor and least educated and service readiness, has health equity effects.

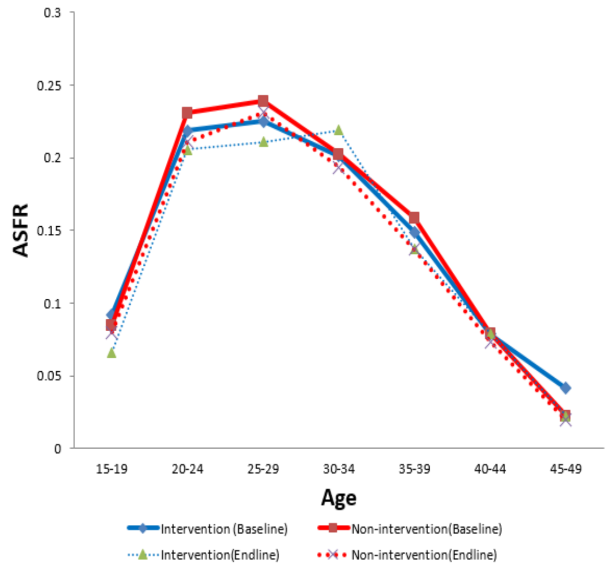
δ_j the nine-month lagged nuisance parameter adjusting for maternal and household characteristic u_l among L such characteristics.

ξ_{jk} is the joint effect of x_j among individuals with background social covariate of parity progression u_k among K such covariates; and

μ_{jk} is the joint effect of exposure to the clinical readiness of facility type *j* among individuals with background characteristic u_k among K such covariates.

Corresponding linear combinations of coefficients estimate the effect of combinations of exposure elements in experimental cells in reference to the comparison area. Such effects control for social indicators, such as maternal educational status. By setting covariates at sample grand means and summing predicted probabilities of (2) for all ages from 15 to 49, this numerical integration of linear combination estimates defines the conditional TFR for UHC exposure relative to conditions lacking this capability.

Figure 1: Age Specific Fertility Rates for Intervention and Comparison Areas at the Baseline (2010) and Endline (2015) of GEHIP



Fertility results:

Based on the birth history data, we computed the age-specific fertility rates (ASFR) shown in Figure 1. Results suggest that women in the non-intervention districts had higher fertility at older ages. The total fertility rate (TFR), was reported to be 5.4 for the entire GEHIP sample at baseline, and slightly higher in the non-intervention are (5.6), relative to the intervention arm (5.3). By the endline, changes were modest: The intervention area TFR was 5.2 versus 5.5 in comparison areas. Discrete time hazard regression results show that GEHIP had a modest, but statistically significant net effect on the TFR.

Conclusion

It is widely assumed, but seldom tested, that family planning access will be addressed if UHC is instituted. GEHIP challenges this assumption with results showing that convenient geographic access has had an only marginal fertility effect, with impact that is limited to women under age 25. This limited impact is associated with a slight impact on contraceptive use and counter-intuitive effects on preferences leading to an increase in unmet need.

Demonstrating this result with statistically rigorous modeling accompanied with of net fertility effects attests to the need for investment in community-based program training and worker deployment that replicate social mobilization strategies that extend CHPS beyond the implementation of clinical UHC. Strategies for addressing the social access needs of women are essential components of the effective development of geographic access to primary care. Social mobilization, community-outreach, connection of family planning discussions with male social networks were elements of the Navrongo family planning success story that have atrophied as CHPS has sealed-up. Results of this research provide knowledge that successful achievement of UHC with CHPS as a primary strategy, requires careful ancillary strategies for ensuring social access to family planning.

References to be provided on request.