Health Program Effects on Individual Use of Services

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A Comparative Multi-Level Analysis of Health Program Effects on Individual Use of Reproductive and Sexual Health Services

Running Title: Health Program Effects on Individual Use of Services

by

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Abstract

This study assesses the influence of health resource inputs, in the form of facilities, commodities and knowledge, on the likelihood of individual use of family and other reproductive health services in four developing countries. The data analyzed are drawn from multi-stage cluster sample surveys in Paraguay, Uganda, Tanzania, and northern India, which selected health facilities and female populations for interviews. Although previous studies are equivocal about such effects, this study finds health-system factors, such as distance, types of services provided, and exposure to health messages, to influence significantly individual consumption of services for contraception, maternity care, and sexual health services, net of demand factors. A strong distance decay effect is observed on women's use of maternity services. The study also finds, however, that in these low-income settings women's consumption of health services is primarily influenced by household and individual socioeconomic status.

Abstract

A Comparative Multi-Level Analysis of Health Program Effects
On Individual Use of Family Planning and Other Reproductive Health Services
Submitted to IUSSP General Population Conference Session S20

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Context. The aims of this study are to assess the effects of health program inputs on the likelihood of individual use of family planning and other reproductive health (FP/RH) services in four developing countries, using appropriate measurement and estimation methods, and to identify which access, quality and educational aspects of programs are effective. The performance of health systems significantly influences the provision and consumption of services and the efficient and effective use of the resources allocated therein. Both public and private health service infrastructures provide the context in which formalized family planning and other reproductive health care occurs and can be assessed at the community level.

Methods. Data from five probability sample surveys of health facilities linked to companion household surveys of women of reproductive age--in Paraguay (1998), Uganda (1997), Tanzania (1991 and 1996) and nothern India (1995)--are used to measure individual- and facility-level factors hypothesized to influence service utilization. The specific FP/RH services studied are modern and clinical contraceptive method use, formal maternity care during pregnancy and at delivery, sexually-transmitted disease symptom reporting and HIV testing. Facility-level predictors measure service access, such as number and type of facility; service quality, such as type and training of health staff, range of services, and availability of medical supplies and

equipment; and service promotion, such as outreach activity. Where more than one facility is present at the sample cluster level, aggregation of resources across facilities is carried out, as is aggregation of resources, such as staff and services, within a facility. Individual-level predictors include the woman's age, level of completed schooling, place of residence, parity, household wellbeing, and exposure to media messages about health. As much as possible, the variables are defined in a standardized manner so as to enable cross-country comparisons.

The likelihood of an individual woman's use of these services is predicted using multilevel multivariate logistic regression with facility- and individual-level predictors. The results are presented in terms of odds ratios and their 95% confidence intervals. The estimation adjusts for the clustering effects from the multi-stage complex survey designs. Random effects estimators are used and an adjusted Wald test, using an F-statistic, is conducted to determine the independence of the health facility-level factors in the models. The statistical significance of the latter validates the importance of health system inputs for the FP/RH utilization outcomes.

Results. Among the individual-level predictors of FP/RH service utilization, across all country surveys, education and urban residence have predominant influence, not surprisingly. Age and parity have strong positive effects on use of modern or clinical methods of contraception but no effect on formal maternity care use. Older women are more likely than younger ones to have ever had an HIV test. Household wellbeing factors, such as asset possession and presence of electricity, are strong predictors of use of formal antenatal and delivery care, both in terms of type of delivery attendant and place.

Exposure to health messages via electronic media significantly increases the likelihood of FP/RH service use in most country settings. Except in Uganda, private health facilities are associated with higher probabilities of use, as compared to public ones. A broader range of FP, maternal and

child health, and sexual health services tends to increase use; and drug stockouts tend, although not consistently, to lower use. A distance decay effect is observed for Uganda and Tanzania, where longer distances lower the probability of use. No clear pattern of effects is seen from staffing quality and community outreach activity. Also, while service-related factors influence HIV testing, they do not predict STD symptom reporting. Controlling for variations in model specifications, the test of joint significance of health facility and individual predictors finds the former to contribute independently and significantly.

Conclusions. The findings are based on cross-sectional data, although the Tanzania 1991 and 1996 surveys involve a panel of sample clusters; but the effects of program targeting can not be determined. Unobserved factors that can predict health service consumption include the status of community development and social network involvement. The study nonetheless capitalizes upon well-designed sample surveys of health facilities and households to link exposure to health systems inputs with consumption behaviors. Assessing the deterministic influence of system variables, in the presence of individual demand predictors, has provided stable and reasonable patterns of results that can guide program officials' and policymakers' decisions about resource investments.

A Comparative Multi-Level Analysis of Health Program Effects on Individual Use of Reproductive and Sexual Health Services

Background

According to the recent World Health Report (WHR) 2000, 84% of the world's population bear 93% of the global disease burden but live in low and middle income countries that account for only 18% of world income and 11% of global spending ($250 billion) on health (WHO, 2000). The WHR focuses attention on national health systems' performance of four key functions--service provision, resource generation, financing and stewardship--to achieve three goals of improving the health of populations served, responding to people's expectations, and providing financial protection against the costs of ill health. Health systems are considered to be "all the activities whose primary purpose is to promote, restore or maintain health" (p. 5), whether undertaken by individuals or collectives, through public or private initiatives. Two of the four functions identified in the WHR's conceptual framework--service provision and financing--require little clarification. A third, resource generation, signifies investing in people, buildings and equipment; and the fourth, stewardship, refers to oversight of the resources, powers and entrusted expectations (see also Murray and Frenk, 2000). The emphasis of the World Health Organization's report is on national health systems' performance as a strategic means for producing good health in a responsive manner and with fairness in financial responsibilities, particularly in settings with a disproportionate share of the global burden of disease.

Roemer (1991) in his respected study of national health systems more than a decade ago cited six rationales for comparative efforts. Three of these have practical implications, i.e., to understand the strategies for 1) achieving health equity, 2) achieving maximum efficiency in resource use, and 3) assessing their influence on health outcomes.[1] These reasons reflect closely the logic of the WHR 2000's interest in health systems performance. With Roemer's study and

the WHR 2000 as bookends to the past decade of international and national health efforts, the research findings that emerged in this period are fairly equivocal on the effectiveness of these contributions to improving health outcomes (e.g, Sahn and Bernier, 1995; Pannarunothai and Mills, 1997; van der Gaag and Barham, 1998). Some macro-level comparisons of health status show no independent connection to levels of public spending on health, health facility or personnel inputs, or access to modern medical care (Filmer and Pritchett, 1999; Schultz 1994; Mackenbach, 1991; Rosenzweig and Wolpin, 1986), while others do (e.g., Frongillo et al., 1997). Micro-level studies observe the disproportionate spending on health care by rural and low-income households (e.g., Parker and Wong, 1997 for Mexico; Hotchkiss et al., 1998 for Nepal), implying public spending and resources for health are inadequate. A possible explanation is that the levels of public expenditures on health may be higher in countries where health system infrastructures are moderately well developed and health outcomes less compromised, as Govindaraj et al. (1997) suggest for Latin American and the Caribbean, while countries with significant disease burdens have severely constrained resources for health investments and the weakest infrastructures. The extent of international assistance to low-income countries, especially on a per capita basis, has been limited in past years and unlikely to register the scale of expected impact on health outcomes, except at the margins (Michaud and Murray, 1994).

Social equity in the allocation of public health resources and access to health care at the community level may be greater than at the national level, permitting observation of stronger relationships between system inputs and performance. Jensen and Stewart (2000) find health expenditures for secondary-level facilities in the Philippines, such as rural health units and hospitals, to increase the use of curative care for sick children. On the other hand, a recent study of local government decisions in Uganda (Akin et al., 2001), where annual per capita government spending on health is only US$14 (WHO, 2000: Table 8), found district planners under a

[1] The other three involve knowledge generation: 1) providing a perspective for understanding one's own health system, 2) identifying common features of health systems, and 3) generalizing from these.

decentralization scheme allocating *declining* proportions of their budgets to public goods activities (such as immunization, safe water, vector and infectious disease control and primary health services). Bloom and McIntyre (1998) also observe little relationship between district health expenditures and child mortality outcomes in South Africa. The disproportionate share of the disease burden in low-income countries may still overwhelm the limited quantity and quality of local health services, independent of how equitably or inequitably resources are allocated across levels.

For developing countries, the equivocal findings on the effectiveness of health system inputs on health outcomes is attributable in part to inadequate measurement, due both to the absence of longitudinal data on health system inputs at the community- level *and* linkage to individual-level behaviors (Frankenberg and Thomas, 2001; Akin et al., 1995). While it is possible to locate cross-national statistics on health status (e.g., WHO 1996, 1998; World Bank 2001), comparative national statistics on health system inputs, even for conventional programs, are virtually nil (see Newbrander et al., 1994). Data from health information systems at the local levels are almost exclusively focused on the public sector and generally too poor in quality to support rigorous but much-needed analyses of resource inputs (Peters et al., 2000). Probability surveys of community-level health facilities can substitute and offer better measurement precision but are carried out irregularly. Vital registration data on births and deaths from national health statistics are similarly too incomplete to warrant linkage with system-level input data. Linked community- and individual-level survey data systems on health service provision, awareness and consumption are thus rare, although emerging with greater frequency (e.g., Frankenberg and Thomas, 2001; Topcuoglu et al., 2000; Steele et al., 1999; DeGraff et al., 1997; Angeles et al., 1998). The absence of adequate measurement has limited the quality and extent of comparative investigations of health system impact on individual utilization behaviors.

The absence of panel observations of health system inputs also restricts the analyst's ability to address measurement bias arising from non-random allocation of public health

resources (Angeles et al., 1998). Program managers' decisions about the distribution of health system resources, such as capital improvements in facility construction, personnel, equipment and supplies, can favor or target specific operating sites as beneficiaries, such as high or low performing health districts or home communities. Similarly, areas where client populations are perceived to have high needs for specific system inputs may be slated to receive additional resources. If the health infrastructure or health outcomes of these beneficiary sites and populations are unusually poor, when correlated with high input levels in the cross-section, a negative association between resource inputs and outcomes can be erroneously concluded. The methodological limitations of measurement and appropriate data systems are increasingly recognized in scientific evaluations of public health and population interventions (e.g., Frankenberg and Thomas, 2001; Steele et al., 1999).

Assessing the effects of health system-level inputs on population-level behaviors inherently calls for hierarchically structured data and appropriate methods of analysis. Multilevel analysis methods offer conceptual compatibility and many modeling advantages, including the ability to construct a causal process with level-specific determinants that are connected through predictor or outcome variables (e.g., see Angeles and Mroz, 2001). For example, one can assess the relationship between district-level resource allocations to various public services and district-level factors, such as population size, budget size, planner priorities, prior health needs, as in Akin et al. (2001). This dynamic can be part of a structural equation system where at a lower level, the system's influences on household expenditures on private or public health care for various family members are studied. A yet lower level model in this system can assess individual health status as a function of personal motivational, physical markers, and household expenditures. This three-equation system within a multilevel model, ideally measured with longitudinal data, allows one to trace the causal linkages hierarchically as to how district decisions on health service access and quality can influence health status or personal response to treatment, through household decision dynamics.

Provision and utilization of family planning and other reproductive health services

Family planning and other reproductive health services, such as antenatal, delivery, postpartum, infertility, along with child health care, comprise a subdomain of primary health care (PHC) for which there has been longstanding national and international interest (see United Nations, 2000; Ross et al., 1999). At the 1978 Alma Ata International Conference on Primary Health Care, family planning and maternal and child health (MCH) services were considered one of the eight essential elements of a minimal PHC package (Ko Ko, 1990). While in the past contraceptive service provision has experienced significant attention as a categorical or vertical health program, the range of services defined as relevant to population and development has expanded since the 1994 International Conference on Population and Development (ICPD) to embrace those that address women and men's sexual and reproductive health needs. The most conspicuous addition has been sexual health services, primarily those to prevent sexually transmitted infections (STIs) that may progress to acute infections such as Human Immunodeficiency Virus (HIV) or Acquired Immunodeficiency Syndrome (AIDS), or to cancers related to sexual organs, such as the cervix or prostate. The amplified definition of reproductive health services targeted for provision does not necessarily require the establishment of new services. Many of these pre-existed the 1994 ICPD embrace and were, as well as continue to be, delivered through different sections of a health ministry or department or by different specialists. ICPD however has focused the efforts of population and health policymakers and planners in government and non-government settings on the organization or re-organization of these services in some integrated fashion, whether administratively or clinically (Tsui et al., 1999).

The United Nations has long monitored government support for contraceptive method access through its Population Policy Inquiry. In the two decades between 1976 when 149 governments responded and 1996 when 179 governments responded, the percent providing direct support increased from 63 to 79 (United Nations, 1998: Table 5). Another study measuring crossnational support of contraceptive method access from 1982 and 1999 finds an average of 29

percent of maximum possible effort expended by countries in 1982 (unweighted) rising to 55 percent in 1999 (Ross and Frankenberg, 1993; Ross and Stover, 2000). Using the 1994 ratings of contraceptive method availability, Ross et al. (1999: Table 5.1) report that among 91 developing countries, 54 percent provide access to at least one long-term and one short-term contraceptive method. Among the 30 Sub-Saharan African countries, only 27 percent provide such access, compared to two thirds of 23 Asian and 24 Latin American countries and 71 percent of 14 Middle Eastern or North African countries. While access levels vary regionally, utilization levels are overwhelmingly of modern methods of contraception, such as sterilization, IUDs, injectables, pills and condoms. In addition, public sector facilities are the dominant source for contraceptive services although private providers are preferred in a growing number of countries, particularly in Latin America (see Smith and Rao, 1996).

Long-term trends in the availability of maternal and perinatal health care across developing countries are less well monitored, although a recent study of 49 countries finds service provision to be low and variable across countries (Ross and Bulatao, 2000). Using Demographic and Health Survey data weighted by the number of deliveries, Ross et al. (1999: Table 4.3) estimate 65 percent of women in developing countries received antenatal care for their last birth, ranging from a high of 74 percent in the Latin America to a low of 58 percent in the Middle East and North Africa. On average about half of women received delivery care for their last child, with a low of 36 percent in Sub-Saharan Africa and a high of 73 percent in Latin America. The latter utilization levels are more optimistic than those reported by the United Nations (2000: Table 26), which circa 1996 finds 40 percent of women in developing countries delivering in a health facility and 53 percent having a skilled attendant at delivery. Factors cited as influencing the use of maternal health services include varying perceptions of need for care, knowledge about when and where to seek care, and ability to overcome physical, economic, social and cultural barriers.

Parallel to, and some times integrated with, preconceptional, pregnancy, delivery and postpartum health services is preventive and curative sexual health care. Sexual transmission is thought to account for more than four fifths of HIV infections globally, and nearly 333 million curable STD infections occur each year, per WHO estimates (UN, 2000). With 30 million or more persons worldwide either HIV infected or living with AIDS, access to and use of health services information and care to prevent STD and HIV transmission have risen rapidly as a global priority. Prevention programs focus primarily on public health messaging and peer education for risk populations and on testing and counseling and condom distribution, with ancillary efforts directed toward reducing HIV/AIDS maternal-to-child-transmission and protecting the blood supply from contamination. Most STDs, following proper diagnosis, are curable by antibiotic treatment, as compared to HIV/AIDS. Until recently anti-retroviral drug therapy access was limited to HIV-infected persons in industrialized countries. Cross-national data from systematic assessments of the availability and quality of STD and HIV/AIDS services are not available, although an HIV/AIDS program effort score has been field tested (Stover, 1999). One sub-national sample survey of 289 health facilities in Uganda in 1999 found that 96 percent provided STD treatment, 75 percent HIV/AIDS counseling but only 27 percent HIV/AIDS testing (Katende et al., 2000).

Efforts to integrate sexual with reproductive health services, particularly family planning, have increased of late (e.g., Mayhew et al., 2000; Hardee et al., 1999) although these are likely to be more evident at the service delivery than administrative level. A number of factors can determine the effectiveness of service integration in either improving awareness of or reducing STD and HIV/AIDS transmission risk. These include whether the client populations are similar in composition, e.g., age and gender; whether preferred sources of family planning or STD care overlap; whether staff are trained to provide family planning care and STD diagnosis, counseling and treatment appropriately; and how staff advise clients about protection from the dual risks of unwanted pregnancy and sexually transmitted infection. For example, contraceptive and maternal

and child health services tend to focus on female clients and may be offered in settings that are unappealing to males, especially younger ones. Also gender-differentiated responsibility for pregnancy and sexual partnering has been observed through in-depth interviews (e.g., Miller et al., 2001), suggesting the responsibility for care-seeking may be similarly gendered. Because the expanded reproductive health paradigm considers sexual health care a necessary component, how health system and program resources influence individual use of that care is relevant.

Study purpose

Our study proceeds on the assumption that the performance of health systems can significantly influence the provision and consumption of services and the efficient and effective use of the resources allocated therein. We focus on the expression of service delivery at the community level in both the public and private sectors. The aim of this study is to assess the effects of particular health system inputs, in terms of their assurance of community-based service access, quality and outreach, on the likelihood of individual use of family planning and other reproductive health (FP/RH) services in four developing countries, using appropriate multilevel analysis methods. Although reliant on cross-sectional data, this study focuses conceptually on two pathways of influence: health information and education, or health messaging, and service utilization. We hypothesize that health system effects on individual health behavior are channeled through 1) increased population-level awareness of health conditions and risks, achieved through either electronic, print or interpersonal information-education-communication (IEC) efforts, and 2) increased service utilization with greater client volume and acceptance. If these effects, net of those from other relevant factors, are negligible, we would conclude that the health system is performing sub-optimally and not reaching client populations with the necessary information about health risks and available services nor providing accessible, quality health care.

The conceptual framework for our study of FP/RH health program effects (at the system level) on individual utilization behaviors follows Roemer's (1991), which identifies four

components to the production of resources: *health manpower, facilities, commodities* and *knowledge*. The health system organizes the production of health resources through deployment of trained health manpower, establishment of health facilities (e.g., hospitals, clinics, pharmacies), rational management of pharmaceuticals, equipment and supplies, and promotion and dissemination of preventive and curative technical knowledge about health (see Figure 1). Health results are achieved in part through care seeking or individual utilization of FP/RH services. Those of specific interest for this analysis are use of modern contraceptive methods, clinical methods of contraception, antenatal services from a trained provider, facility-based delivery care, delivery by a trained attendant, and HIV/AIDS testing.

Data and variable measurement

Sources of data. The data analyzed in this study are taken from several national or large-area probability sample surveys of health facilities and households in Paraguay, Uganda, Tanzania and northern India. The health facilities surveys, by design, are based on area cluster samples used to select households and then individual women meeting any age and marital status criteria. Descriptions of each country's multi-stage cluster survey and the extracted analysis samples are given below and summarized in Table 1. Further sample design and fieldwork details are available from the cited survey reports.

Table 1. Survey design and individual and health facility sample information: Paraguay, Uganda, Tanzania and India

Survey feature	Paraguay	Uganda	Tanzania		India
SURVEY DESCRIPTION					
Year	1998	1997	1991	1996	1995
Geographic coverage	Subnational (Central, Cordillera, Misiones departamentos) with 30% of country's population	Subnational (9 of 39 districts with 20% of country's population)	National	National (except Zanzibar)	Uttar Pradesh state with 16% of country's population
Implementation agency	Centro Paraguayo de Estudios Poblacion, Centers for Disease Control/Reproductive Health Surveys, and MEASURE Evaluation	Pathfinder International and MEASURE Evaluation	Bureau of Statistics, Tanzania and Macro International/ Demographic and Health Surveys	Bureau of Statistics, Tanzania and MEASURE DHS+ and MEASURE Evaluation	Center for Population and Development Studies/Hyderabad and the EVALUATION Project
INDIVIDUAL SAMPLE					
Selection criteria	One woman randomly selected from sampled households 15 to 44 years (n=2,150)	All women in sampled households 15 to 49 years (n=1,698)	All women in sampled households 15 to 49 years (n=9,238)	All women in sampled households 15 to 49 years (n=8,120)	All married women in sampled households 13 to 49 years (n=45,262)
Analytic sample size for FP service use	2,150 women	1,698 women	8,718 women in 327 clusters (a)	7,749 women in 327 clusters	44,334 women
Analytic sample for RH service use (women who gave birth in the last X years)	1086 women giving birth in last 5 years	846 women giving birth in last 36 months	5023 giving birth in last five years	4171 women giving birth in last 5 years	19,947 women giving birth in last 3 years; of these 3172 women in 5 RH districts (b)
FACILITY SAMPLE					
All facilities	144 health facilities (125 public and 19 private) in 3 departamentos	173 health facilities (111 public and 61 NGO/private)	388 health facilitites (315 public, 73 NGO/private) in 327 sample clusters on the mainland (excludes Zanzibar)	466 health facilities (373 government, 93 NGO/private) in same 327 clusters as 1991	2,548 fixed service delivery points (2,158 public, 390 NGO/private)
Selection criteria	All health facilities in 3 departamentos	Most used health facility proximate to sample cluster (58) and 114 Data Collection Coordinating Points	Closest of 5 main facility types (hospital, health center, dispensary, private doctor, pharmacy) visited during household survey in sample cluster (357 clusters)	Closest of 3 facility main types (hospital, health center, dispensary) visited during household survey in sample cluster (327 clusters); also all 10 UMATI and 5 Marie Stopes facilities in country.	All health facilities within boundaries of or assigned to sample cluster (village or urban block); subset of 390 health facilities in 5 RH districts

(a) A panel of 327 clusters sampled in 1991 (excluding those in Zanzibar) were followed up in the 1996 survey. Facilities established in those clusters after 1991 were included in the 1996 survey.

(b) 5 of 28 sample districts were designated for additional RH data collection

Paraguay. The health facility survey was designed to assess health care decentralization (see Angeles et al., 1999) and was conducted in 1998 by the MEASURE Evaluation project. Geographic coverage of the health facility survey is restricted to three departamentos (Central, Cordillera, and Misiones) slated by the government for decentralized health authority and containing 30 percent of the country's population, including the capital, Asuncion. The population-based survey, the Encuesta Nacional de Salud Materno Infantil (ENSMI)[2], was conducted by the Centro Paraguayo de Estudios de Poblacion (CPEP) in the same year. The ENSMI 98 subsample for these departamentos includes 2,150 women ages 15 to 44, and the health facility survey interviewed a census of 125 public health facilities and a sample of 19 private health facilities.

Uganda. The health facility and population surveys were carried out in 1997 by the Delivery of Integrated Services for Health (DISH) project, implemented by Pathfinder International (see Katende et al., 1999). The DISH project focuses on 9 of 39 districts, containing 20 percent of the national population. From a subsample of the 1995 Uganda Demographic and Health Survey clusters, 173 of 190 selected health facilities (111 public and 61 private) were successfully interviewed (91 percent response). For the population survey 1,698 women ages 15 to 49 or 92 percent (and 900 men ages 15 to 54 or 96 percent) were interviewed of those selected from the probability sample of 2,000 households.

Tanzania. Two rounds of national surveys were conducted in 1991 and 1996 by the Bureau of Statistics, Planning Commission, of the Government of Tanzania. The health system-level surveys are referred to as the 1991 and 1996 Tanzania Service Availability Surveys (TSAS91 and TSAS96, see Bureau of Statistics and Macro International, 1997 and Bureau of Statistics and the EVALUATION Project, 1997). The population-level surveys were national in scope in 1991 and 1996 and carried out in conjunction with the Demographic and Health Survey

[2] Financial support for all surveys was provided by the U.S. Agency for International Development (USAID) and technical support for the health facility surveys in Paraguay, Uganda,

program. The 1991 sample size was 9,238 women aged 15 to 49 years from 357 sample clusters that included the island of Zanzibar. In 1996 the female sample was 7,749 women of the same age range in 327 clusters, excluding the 30 in Zanzibar.

TSAS91 administered the Service Availability Module which demarcated a 30km radius around the cluster and visited the closest of each of five main types of public or private facilities: hospital, health center, dispensary, private clinic and pharmacy. Interviews were successfully completed with 388 health facilities, 315 of which were public. TSAS96 revisited the 1991 facilities, an additional 63 facilities that declined to participate in 1991 and another 15 non-governmental organization clinics, i.e. 10 belonging to UMATI, the national family planning association, and 5 to Marie Stopes International. Missing in 1996[3] were revisits to private doctors' clinics and pharmacies.

India. The PERFORM Survey of Uttar Pradesh state in northern India, covering 150 million or 17 percent of the country's population, was conducted in 1995 by the State Innovations in Family Planning Services Agency (SIFPSA) and coordinated by the Center for Population and Development Studies (CPDS) in Hyderabad (see SIFPSA et al., 1996). The PERFORM Survey covered all 14 divisions of the state, sampling two districts from each, and then urban blocks or rural villages by stratum size, which were the primary sampling units (PSUs). Within each PSU, all public or private sector health institutions were selected. If not within the PSU, all government health centers designated to provide services to the PSU's population were visited for an interview, as were private hospitals with 10 or more beds in the nearest town within 30 kms, all NGO or employer clinics or hospitals, and the district and medical college hospitals. A sample of 2,548 health facilities, of which 2,158 belonged to the public sector, was interviewed (95 percent response rate). As the PERFORM Survey focused on family planning service provision, 5 of the 28 districts, representing one from each of the state's five regions, were

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Tanzania 1996 and northern India was provided by the MEASURE Evaluation Project, Carolina Population Center, University of North Carolina at Chapel Hill.

[3] These were included in the 1999 TSAS round.

selected for a reproductive health supplement to the questionnaire. A subset of 390 health facilities then provided RH service delivery data.

All married women between the ages of 13 to 49 were selected from 40,633 households for interview, generating a sample of 45,262 women or a 94 percent response rate. Of these 44,334 women (98 percent) had complete data for the family planning analysis.

The analyses involving use of maternity care services are restricted to those women giving birth in a recent period before the survey, which varies by country setting. In the case of Paraguay and Tanzania (both rounds), women with births within 5 years of the survey answered questions about pregnancy, delivery and postpartum care. In the case of Uganda and Uttar Pradesh, India, women were asked about maternity care occurring within 3 years of the surveys. The sample sizes of recent mothers for the RH service analyses are then 1,086 (Paraguay), 846 (Uganda), 5,023 (Tanzania 1991), 4,171 (Tanzania 1996), and 3,172 (5 districts of Uttar Pradesh).

Across these five data sources, the sampling procedures for individual women follow what has become a conventional multi-stage cluster approach for population-level surveys, while those for health facilities vary. Although the intention was to select health facilities on a probability basis to characterize the actual distribution of facilities in a given area, the actual sampling protocols varied within and across surveys. In the case of Paraguay, the sub-national census covered all public health facilities but only a sample of private ones. In Uganda, some of the 173 facilities were selected on the basis of being the most used, the nearest, or identified as the main source for contraception. In Tanzania the 1991 selection procedures both excluded smaller facilities likely to be present multiple times in a geographic area and those distant from the sample clusters. In 1996 the objective of constructing a panel of facilities focused on only three main types from the 1991 round and excluded many small and private health providers. In Uttar Pradesh the sampling approach is the most comprehensive, although geographic coverage is limited to a state, albeit one very populous. The rationale and issues involved in sampling health facilities independent of or conjoined with population sampling can be found in Turner et al.

(2001). For our purposes, we must necessarily exercise care in generalizing about patterns of results given the varied sampling protocols. The benefits of studying the relationship of health system resources manifested at the community level and individual service use comparatively, however, outweigh the limitations.

Variable measurement. Table 2 provides the variable definitions used across the five data sources. While these have been constructed with comparability as a major underlying goal, not all dependent and independent variables are available in each country's survey. Standard are the contraceptive and maternity service use variables, specifically whether or not the woman reports using a modern contraceptive method or a clinical contraceptive method[4] at the time of the survey, receiving antenatal or delivery care for her last birth from a formal or skilled health provider[5], or delivering at a facility, as opposed to home. Use of a clinical contraceptive method is analyzed among contraceptors only. Use of sexual health services is limited to whether the respondent reports ever being tested for HIV/AIDS which is available in the Uganda and Tanzania 1996 surveys.[6] All utilization variables are dichotomously measured.

[4] Clinical methods are IUD, sterilization or implant.
[5] A formal or skilled provider is a doctor, nurse or trained midwife.
[6] STI treatment levels were too minimal to permit analysis.

Table 2. Variable definitions used in analysis: Paraguay, Uganda, Tanzania and Uttar Pradesh, India

Variable	Definition	Coding	Paraguay 1998	Uganda 1997	Tanzania 1991	Tanzania 1996	U.P., India 1995
Contraceptive method use							
Modern method use	Woman's (or spouse's) current use of modern methods	Modern method (pill, IUD, sterilization, injectable, implant, condom) = 1 Traditional (rhythm, withdrawal, folk, other)/None = 0	x	x	x	x	x
Modern clinical method use	Woman (or spouse's) use of a modern clinical method (among current contraceptors)	Using a clinical method (IUD, sterilization, implant) = 1; Using other modern method (injectable, pill, condom) = 0	x	x	x	x	x
Maternity care use							
Antenatal care provider	Type of antenatal care provider for last birth	Doctor/nurse/midwife = 1; TBA/other/none = 0	x	x	x	x	x
Place of delivery	Place of delivery for last birth	Facility = 1; Home = 0	x	x	x	x	x
Delivery attendant	Attendant at last delivery	Doctor/nurse/midwife = 1 TBA/friend/relative/other/ none = 0	x	x	x	x	x
STD/HIV care use							
HIV testing	Ever tested for HIV	Yes = 1 No = 0		x		x	
Female respondent and household characteristics							
Age	Age in years	15-19 (REFERENCE) 20-24 25-29 30-34 35-39 40-44 (or 49)	x	x	x	x	x (Age group 15-19 includes females aged 13-14)
Education	Level of last year of completed schooling	No education (REFERENCE) Primary Secondary	x	x	x	x	x
Residence	Current place of residence	Rural = 0 (REFERENCE) Urban = 1	x	x	x	x	x
Children ever born	Number of live births	0 - 1 (REFERENCE) 2-3 4-6 7 +	x	x (Number of living children)	x	x	x
Electricity	Presence of electricity in household	Yes = 1 No = 2 (REFERENCE)	x		x	x	x
Household assets	Cumulative number of household assets	Low (0-1) = 0 (REFERENCE) Medium (2-3) = 1 High (4 or more) = 2	x (telephone, radio, TV, fridge, video, washer, motorcycle, car)		x (radio, TV, fridge, bicycle, motorcycle, car)	x (radio, TV, fridge, bicycle, motorcycle, car)	x (clock, fan, radio, TV, bicycle, car)
FP message exposure by media channel	Exposure to electronic and print media messages about FP	None = 1 (REFERENCE) Electronic = 2 Print only = 3		*x* last 6 months (radio, TV, newspaper, poster, leaflet)		*x* last 6 months (radio, TV, newspaper, poster, leaflet)	x Print category also includes interpersonal
STD/HIV/AIDS message exposure by media channel	Exposure to electronic and print media messages about STD/HIV	None = 1 (REFERENCE) Electronic = 2 Printonly = 3		*x* last 6 months (radio, TV, newspaper, poster, leaflet)		*x* source of information on AIDS (radio, TV, newspaper, poster, leaflet)	

Among the individual- and household-level predictors are respondent's age, completed education, current place of residence, parity, household availability of electricity and cumulative number of assets, and exposure to family planning, STD/HIV and antenatal care media messages as likely influences of service use. All these selected factors are known to be socioeconomic or demographic determinants of family planning or other reproductive health service utilization. Age, schooling, parity, household assets and message exposure are measured categorically to allow observation of nonlinear relationships with utilization outcomes. Age is categorized into five-year age groups, schooling into none/primary/secondary or higher groups, parity into 0-1, 2-3, 4-6, and 7 or more births, and cumulative household assets into low (0-1), medium (2-3) and high (4 or more) levels. While the specific combinations of assets inventoried in each survey vary somewhat, as detailed in Table 2, domestic appliances, mass media equipment, and vehicles are the common types. Place of residence (rural/urban) and household electricity are dichotomously measured. Health message exposure is grouped into no exposure, electronic and/or print, and print only.

The facility-level predictors are less standardized, reflecting not only the nascency of measurement and research experience in this area but also the inherent complexity involved in organizing health resources to deliver each of the contraceptive, pregnancy, maternity and sexual health services. We are guided by Roemer's conceptualization of a national health system (1991) as shown in Figure 1, wherein health resources are represented by the sub-components of health manpower, facilities, commodities and knowledge. Health manpower is operationalized in terms of the number, type and family planning service capabilities of facility staff. Health facilities are characterized in terms of level, range of services, physical accessibility or distance from the sample cluster, and thus the respondents, and the facility's operating authority (government or private). Commodities are measured by the availability of requisite drugs and supplies. Health knowledge involves both knowledge generally possessed by staff but also that disseminated

through outreach activities.[7] These operationalizations are not exhaustive of health resources production but include those empirically measured in most health facility sample surveys.

Specifically, health facility type is categorized as primary, secondary or tertiary, with primary being more community-based and tertiary involving more technically sophisticated medical services. The range of family planning and sexual and reproductive health services is measured in terms of the number of contraceptive methods, MCH services, and STD/HIV services offered at the facility. The country-specific composition of the types of services provided and inventoried is shown in Table 2. We count the availability of four common MCH services (antenatal, delivery, postnatal, and immunization) and in Paraguay and Tanzania two additional ones (growth monitoring, oral rehydration therapy). For STD and HIV services, we count the availability of related diagnosis, counseling and treatment care in Uganda and Tanzania. Distance to the nearest facility (in kilometers) is measured continuously in each country except India where this information is not available. Instead the density of primary, secondary and tertiary facilities for the sample PSU is used.

For health manpower, we measure the number of trained doctors and paramedics (nurses, midwives, medical assistants) at facilities, information that is commonly available. In addition the numbers of doctors and paramedic staff trained in family planning are also measured in all surveys.[8]

The on-site availability of commodities specific to each major area of care is determined at the time of the survey. Having commodities in stock signals a facility's preparedness to dispense needed drugs and medications to clients. Out-of-stock situations can reflect either recent excess demand by patients for medications or problems in drug procurement and distribution. In

[7] As Figure 1 indicates, in Roemer's conceptualization health resources is one of four major components of a national health system. The other three are organization of programs, economic support mechanisms, and management methods which individually influence the delivery of services that in turn affects health status (1991:33). The functional coverage is similar to those articulated in the WHR 2000 (service provision, resource generation, financing and stewardship).
[8] To simplify the multivariate analysis comparisons we measure most facility-level resources linearly, although some are likely to have nonlinear relationships with individual use behaviors.

the case of contraception, the number of methods out of stock is totalled for each facility. Similarly a count of total essential MCH drugs (e.g., folic acid, iron tablets, oral rehydration salts, and vaccines) not in stock is obtained. The stockout situation of STD drugs is assessed generally (any recent or none) in Uganda and Tanzania.

Finally the availability and dissemination of technical health knowledge at the health facility level is assessed in all countries by counting trained staff and whether or not outreach activities are conducted. The latter includes health promotion activities through mass media, print and interpersonal channels (such as home visits or group meetings).

Linkage of cluster- to individual-level records. The number of health facilities identified for sample selection at the cluster level can range from zero to some number. Linking the records of selected facilities to those of individuals requires some set of decision rules, which will affect the substantive interpretation of any observed health resource effects. For example, linking can be carried out with all facilities, with only the closest one or closest of several types, with those within a given distance, or with those possessing a specific characteristic. Each approach measures a different aspect of the local health resource environment, e.g., physical proximity, density, and service quality. In our analysis we link the record of the female respondent to information aggregated for <u>all</u> facilities sampled for her cluster.[9] This approach best measures the health resources in her proximate community-based environment and the set of choices most immediately available to her when seeking care.

Table 2 details the measurement basis for each facility-level predictor. For example access to trained doctors is the total number of doctors present in all health facilities selected for a given cluster. This information is added to the record of each woman selected in that cluster. Thus suppose 28 female respondents and 4 health facilities are sampled in cluster W, where facility A (the government health center) has three doctors, facilities B and C (private clinics)

[9] In Paraguay data from the nearest of each of three different types of facilities (hospitals, health centers and health posts) are used. In Uganda only the nearest facilities (58) could be linked to the women's data.

each have one doctor, and facility D (a pharmacy) has none. The count of five doctors in cluster or community W is added to each of the 28 women's records as the doctor access variable. The procedure is replicated for each facility-level variable with hypothesized influence.

Alternative measurement approaches are possible for the doctor access variable. We could have used instead the average, or 1.2 doctors per facility, or constructed the resource factor in a dichotomous manner, e.g., whether or not at least one of the cluster health facilities had a trained doctor or had 2 or more trained doctors. The nature of the selected metric assesses the local health resource situation along different dimensions. Our decision rules favored calculating sums where facility health resources are present with some frequency (e.g., staff or types of services) and measuring presence or absence of resources where they are infrequent.

Analysis methods

The hierarchical structure of the cluster- and individual-level data renders multilevel models as an appropriate analytic approach (Guo and Zhao, 2000). Particularly for evaluating public health interventions, such as family planning and other reproductive health services, wherein we assume individuals in a given area are equally exposed to locally introduced improvements in health care, multilevel analysis with panel data is a recommended methodology in the absence of a randomized experiment (see Angeles and Mroz, 2001).

To fix ideas, consider a linear model that relates one of the outcome variables to a set of explanatory variables plus error terms:

$$Y_{ij} = X_{ij}\beta + \alpha P_{ij} + \mu_j + \varepsilon_{ij}$$

where the dependent variable is for the ith respondent ($i = 1, 2, \ldots, N_j$ individuals in cluster j) in cluster j ($j = 1, 2, \ldots, M$). P_{ij} represents the cluster-level health resource factors to which individuals in cluster j are exposed and X_{ij} represents individual level control variables. μ_j and ε_{ij} are the error terms at the cluster and individual levels respectively which are assumed to be uncorrelated with each other, to have zero means, and to have constant variances. β and α represent parameters to be estimated.

In all cases the outcome variable is dichotomous which means that linear regression methods are not appropriate. We use the logistic regression maximum likelihood method for all estimations. While this method produces correct point estimates of the coefficients, the standard errors and hence t statistics are incorrect because of the error specification laid out above where it is hypothesized that there is a cluster-level error term that affects all individuals who are resident in the same sample cluster. In order to obtain correct standard errors, we use the Huber-White sandwich estimator for the asymptotic covariance matrix.

Following estimation of the models, we conduct joint hypothesis tests, that the coefficients of the family planning and other reproductive health resource variables are zero. We present the F statistics from the adjusted Wald tests and interpret their statistical significance in terms of the independent contribution of the health resource factors to explaining variation in individual use of services. This test is important for statistical inference about the relative impact of system-level inputs on individual service utilization. If statistically significant, we can then examine the relative effects of different health system or program resources on the various family planning and other reproductive care outcomes. By calculating a single F-statistic per estimation, we are able to obtain some comparability across regressions despite the varying model specifications.

Findings

The levels of utilization of family planning, other reproductive and sexual health services measured in the various surveys are provided in Table 3 and seen in Figure 2. Current use of modern contraceptives among women of childbearing age (and currently married in the case of Uttar Pradesh state) range from a low of 5 percent in Tanzania in 1991, rising to a high of 39 percent in Paraguay, with intermediate levels of 13 percent in Tanzania in 1996, 18 percent in Uganda, and almost 25 percent in Uttar Pradesh,. The proportion of use that involves a clinical method is as high as 77 percent in Uttar Pradesh, because of the dominance of female

sterilization, and as low as 15 percent in Uganda and 16 percent in Tanzania (1996). Such variation suggests contraceptive service inputs may play a significant role in the utilization of clinical methods.

Table 3. Percent distribution of female respondents by FP/RH service utilization: Paraguay, Uganda, (1991 and 1996) and Uttar Pradesh, India

Variable	Paraguay 1998	Uganda 1997	Tanzania 1991	Tanzania 1996	U.P., India 1995
Current FP modern method used					
N	2150	1698	8718	7479	44,331
Modern method	38.7	18.4	5.1	13.0	24.6
None or traditional method	61.3	81.6	94.9	87.0	75.4
Current use of clinical FP method					
N	831	312	445	969	10,908
Using clinical method	36.6	14.7	33.3	16.3	76.8
Using other modern method	63.4	85.3	66.7	83.7	23.2
Antenatal care provider used for last birth					(a)
N	1086	1242	5012	4150	3172
Doctor/nurse/midwife	96.7	82.5	59.0	53.5	41.5
Any other or none	3.3	17.5	41.0	46.5	58.5
Place of delivery for last birth					(a)
N	1086	1242	5008	4055	3166
Home	17.6	46.6	51.4	52.1	84.3
Health facility	82.4	53.4	48.6	47.9	15.7
Attendant at delivery for last birth					(a)
N	1086	1242	5010	4157	3130
Doctor/nurse/midwife	99.6	52.2	41.7	43.0	22.7
Any other or none	0.4	47.8	58.3	57.0	77.3
Ever tested for HIV				(b)	
N	na	1686	na	7210	na
Yes	na	13.7	na	4.5	na
No	na	86.3	na	95.5	na

(a) Female respondents with a birth in the last 3 years, in 5 RH districts only
(b) Women who ever had sex and ever heard of HIV/AIDS

The proportion of recent mothers receiving antenatal care for their last birth from a skilled provider is nearly universal in Paraguay (97 percent) but only 42 percent for Uttar Pradesh. Tanzania levels are 59 percent in 1991 and 54 percent in 1996. Health facility-based deliveries occur to just under half of Tanzanian mothers in either 1991 or 1996 and slightly higher levels (57-58 percent) have a skilled attendant at delivery. Just over half (53 percent) of

Ugandan mothers delivered their last births in facilities and nearly the same proportion (52 percent) were attended by a skilled health provider. Facilities are delivery sites for nearly four fifths (82 percent) of Paraguayan mothers, although virtually all had a trained provider at attendance. The lowest level of use of maternity services is seen in Uttar Pradesh where 16 percent of mothers delivered at facilities and 23 percent had a skilled provider in attendance.

Use of STD services was the desired analytic outcome, but empirically this outcome was either infrequently measured across countries or too low to permit analysis (e.g., 2.4 percent of those with infections in Tanzania 1996 sought treatment). Instead ever having been tested for HIV/AIDS, measured in both Uganda and Tanzania 1996, is used as the sexual health care outcome. In Uganda 14 percent of women report ever being tested and in Tanzania 5 percent.

We are interested in the compositional characteristics of the potential client population, observed in Table 4, and those of the health facilities, as seen in Table 5.

Table 4. Percent distribution of individual and household characteristics of female respondents: Paraguay, Uganda, Tanzania (1991 and 1996) and Uttar Pradesh, India

Characteristic	Paraguay		Uganda		Tanzania				U.P., India	
	N	%	N	%	1991 N	%	1996 N	%	N	%
	2150	100.0	1698	100.0	8718	100.0	7479	100.0	44,334	100.0
Woman's age									(b)	
15-19	435	20.2	388	22.8	2053	23.5	1598	21.4	5904	13.1
20-24	366	17.0	391	23.0	1778	20.4	1538	20.6	9486	21.0
25-29	369	17.2	315	18.6	1502	17.2	1331	17.8	8877	19.6
30-34	391	18.2	221	13.0	1106	12.7	1023	13.7	7444	16.5
35-39	327	15.2	195	11.5	948	10.9	819	11.0	6055	13.4
40 and over	262	12.2	109	6.4	1332	15.3	1170	15.6	4508	10.0
Woman's education										
None	20	0.9	407	24.1	2928	33.6	2128	28.5	31094	70.2
Primary	1030	47.9	759	44.9	5429	62.3	5007	67.0	4575	10.3
Secondary or more	1100	51.2	523	31.0	360	4.1	344	4.6	8641	19.5
Place of residence										
Rural	1447	67.3	1023	60.3	6576	75.4	5760	77.0	33692	76.0
Urban	703	32.7	674	39.7	2142	24.6	1719	23.0	10639	24.0
Children ever born			(a)							
0-1	374	24.3	279	16.6	3510	40.3	3028	40.5	11708	26.4
2-3	649	42.1	457	27.2	1922	22.0	1643	22.0	13528	30.5
4-6	384	24.9	397	23.6	1935	22.2	1668	22.3	13936	31.4
7 +	135	8.7	167	9.9	1351	15.5	1140	15.2	5161	11.6
Has electricity										
Yes	2047	95.3	na	na	687	7.9	826	11.0	18472	41.7
No	102	4.7	na	na	8031	92.1	6659	89.0	25862	58.3
No. of household assets										
Low (0-1)	229	10.7	na	na	4289	49.2	2923.0	39.8	12884	29.1
Medium (2 - 3)	774	36.1	na	na	3020	34.6	2613.0	34.9	17426	39.3
High (4+)	1143	53.3	na	na	1408	16.2	1893.0	25.3	13995	31.6
FP media exposure										
None	na	na	406	23.0	na	na	3886	52.0	24056	54.3
Electronic	na	na	1135	64.3	na	na	3326	44.5	17270	39.0
Print only	na	na	224	12.7	na	na	266	3.6	2968	6.7
STD/HIV media exposure										
None	na	na	392	22.2	na	na	2575	34.4	na	na
Electronic	na	na	1130	64.0	na	na	4752	63.5	na	na
Print only	na	na	243	13.8	na	na	152	2.0	na	na
ANC media exposure										
None	na	na	456	26.8	na	na	na	na	na	na
Electronic	na	na	939	55.3	na	na	na	na	na	na
Print only	na	na	304	17.9	na	na	na	na	na	na

(a) Number of living children
(b) Age category 15-19 includes 360 married women aged 10-14 years

The age structure of the females is relatively similar across the countries and nearly identical for the two Tanzania survey rounds. Slightly younger women are found in Uganda than in the other settings. The Paraguayan sample is the most educated with just over half of the women completing secondary or higher levels. The highest percentage of uneducated women is in Uttar Pradesh (70 percent). Three fifths or more of the women in all countries live in rural areas, and three-quarters or higher in Tanzania (both rounds) and U.P. In terms of parity, women in Tanzania have larger families with about 15 percent having 7 or more children, while

Paraguayan women have the lowest, if moderate, level of fertility. In terms of household conditions, 95 percent of Paraguayan women have electricity at home compared to only 8-11 percent for Tanzania (both rounds) and 42 percent for Uttar Pradesh women. Tanzanian women also have the lowest household asset level[10] while Paraguayan women the highest (53 percent have four or more assets). Uttar Pradesh and Tanzanian women have the least exposure to recent family planning messages, while 64 percent of Uganda respondents reported hearing them in the mass media. A similar proportion of Ugandan and Tanzanian (1996) respondents reported hearing STD/HIV messages broadcast in the mass media. In Uganda 55 percent reported recently hearing antenatal care messages in the mass media. Comparatively speaking, the survey data from these Latin American, sub-Saharan African, and Asian countries provide sufficient heterogeneity in social, demographic and economic attributes of the client populations by which to study their relative influences as determinants of health care consumption.

[10] Measures of household electricity and assets are not available in the Uganda survey. Respondent's media exposure is not measured in Paraguay, while it is available in the other countries and for maternity and STD messages as well.

Table 5. Percent distribution of selected health facility characteristics: Paraguay, Uganda, Tanzania (1991 & 1996) & Uttar Pradesh, India

	Paraguay		Uganda		Tanzania				U.P., India	
Characteristic	N	%	N	%	1991 N	%	1996 N	%	N	%
	144	100.0	172	100.0	388	100.0	481	100.0	2548	100.0
Type of facility										
Primary	69	47.9	79	45.9	218	56.2	253	52.6	1267	49.7
Secondary	44	30.6	71	41.3	89	22.9	138	28.7	649	25.5
Tertiary	31	17.3	22	12.8	81	20.9	90	18.7	632	24.8
Operating authority										
Government	125	86.8	111	64.5	315	81.2	373	78.4	2158	84.7
Private	19	13.2	61	35.5	72	18.8	108	21.6	390	15.3
Mean distance to nearest facility (kms) (A)										
Nearest hospital	6	17.5			81	31.7	90	17.4	na	na
Nearest health center	30	6.4	172	2.5	89	20.5	123	14.3	na	na
Nearest dispensary/health post	35	6.9			218	5.4	253	5.5	na	na
NGO (UMATI, Marie Stopes)							15	6.7		
Availability of FP/MCH/STD services										
Family planning	144	80.6	172	88.5	388	93.0	481	92.1	2548	94.6
Antenatal care	144	82.6	172	83.3	388	94.3	481	92.5	389	85.9
Delivery care	144	47.2	172	72.4	388	88.1	481	81.1	389	82.5
Postnatal care	144	77.8	172	65.5	388	73.6	481	77.5	389	36.8
Emergency obstetric care	na	na	58	33.3	na	na	na	na	389	34.2
Child growth monitoring	144	72.2	na	na	388	97.9	481	91.5	na	na
Oral rehydration therapy	144	88.2	na	na	388	17.8	481	95.4	na	na
Immunizations	144	88.2	172	82.8	388	95.1	481	92.3	389	91.3
STD treatment	na	na	172	78.2	na	na	481	91.3	389	28.3
STD diagnosis	na	na	na	na	na	na	481	60.9	na	na
STD counseling	na	na	na	na	na	na	481	58.2	na	na
HIV/AIDS testing	na	na	26	14.9	na	na	481	67.2	na	na
HIV/AIDS counseling	na	na	172	63.2	na	na	481	64.2	na	na
Availability of selected contraceptive methods (C)										
Pill	116	96.6	154	96.1	360	85.0	443	97.3	2290	90.7
IUD	116	78.5	154	21.4	360	29.4	443	51.0	2290	88.1
Condom	116	95.7	154	94.2	360	83.6	443	95.9	2290	90.5
Injectable	116	79.3	154	95.5	360	34.2	443	96.6	na	na
Female sterilization	116	17.2	154	16.2	360	17.2	443	20.8	2290	21.9
Male sterilization	116	12.1	154	13.6			443	11.5	2290	22.3
Availability of selected child vaccines										
BCG	127	91.3	na	na	na	na	444	97.8	na	na
Polio	127	100.0	na	na	na	na	444	98.2	na	na
DPT	127	100.0	na	na	na	na	444	98.0	na	na
Measles	127	98.4	na	na	na	na	444	98.0	na	na
Health staff (Mean, SD)										
Doctors	144	7.4 (13.4)	172	0.5 (1.3)	388	0.9 (2.5)	481	1.6 (12.2)	2548	1.4 (3.2)
Nurses	144	1.5 (3.4)	172	2.7 (5.0)	388	7.4 (15.8)	481	12.9 (59.3)	2548	1.1 (4.9)
Paramedics	na	na	172	1.7 (2.6)	388	6.7 (9.8)	481	6.2 (10.8)	2548	3.5 (7.1)
FP trained health staff (Mean, SD)						(B)		(B)		
Doctors	144	0.7 (1.8)			388	14.2	481	15.8	2548	0.8 (1.3)
Nurses	144	0.5 (0.8)	172	1.8 (1.6)	388	37.1	481	45.1	2548	0.2 (0.8)
Paramedics	na	na			388	71.9	481	60.3	2548	1.9 (2.0)
Number of stocked-out methods recently (Mean, SD) (C)									(D)	
FP methods	116	1.0 (1.3)	154	0.3 (0.6)	360	0.5 (0.9)	443	0.9 (1.2)	2290	0.9 (1.2)
MCH drugs	144	0.2 (0.6)	170	0.6 (0.9)	374	1.4 (1.5)	465	1.4 (1.5)	367	2.9 (1.1)
Immunization vaccines	127	0.2 (0.8)	na	na	na	na	444	1.0 (1.8)	na	na
Any STD drug stockout (B)	na	na	51	29.7	na	na	268	60.0	117	51.8
Health promotion/IEC activities										
Any IEC activity			172	73.3	153	39.5	481	66.3	2548	36.5
Any FP IEC activity	144	73.6								
Any MCH posters	52	92.0								

N=Number of eligible facilities
(A) Mean distance to nearest facility calculated at the cluster level; Ns shown reflect the number of facilities by types with distance measure to the calculation. (B) Percent of facilities with any staff type trained in family planning. (C) In facilities providing services
(D) MCH and SH data collected in only 5 districts (n=389 facilities).

Table 5 presents the compositional characteristics of the health facility samples. Expectedly, in these distributions of health facilities the majority is at the primary level--anywhere from half to three fifths. Tertiary care facilities, predominantly hospitals, range from being 13 percent of facilities sampled in Uganda to 21 percent in Tanzania 1991. The breakdown by level is moderately similar across surveys, which is encouraging given the varying sampling protocols.

In Tanzania (1996 and 1996) and northern India, where the health facility surveys are representative at the national and state levels respectively, the government is the predominant operating authority, ranging between 78 to 85 percent of sampled facilities. Although the Uganda and Paraguay surveys are not statistically representative of the composition and distribution of all health providers, facilities operated by the government similarly predominate. Health care consumers may not necessarily obtain most of their services from public health facilities, despite services often being free; nonetheless the government is the major supplier of health resources in these low-income settings.

The average distance to the nearest hospital from the cluster center is 17.5 kms in Paraguay. (These distances would apply to sampled respondents from the clusters.) In Tanzania (1991) the average distance to the nearest hospital was 31.7 kms but in 1996, with the inclusion of more hospitals in the sample, the average distance dropped to 17.4 kms. Distance to the health dispensary is on average 5.4-5.5 kms in Tanzania and just under 7 kms to the nearest health post in Paraguay. Because the health post or dispensary is the primary health unit intended to be the most accessible, especially to rural populations, confirmation through these measured distances is again encouraging. In Uganda, the average distance to the nearest health facility of any type, most likely either a health dispensary or center, is 2.5 kms. The average distance to a NGO clinic providing family planning in Tanzania 1996 is 6.7 kms.

Across the surveys, over four-fifths of facilities offer family planning services, and contraceptive services appear to be more accessible than even some basic maternal and child

health services. The pill and condom are the methods most frequently found in family planning facilities, with four fifths or more offering both. The injectable is almost equally as common as the pill in family planning facilities in Uganda and Tanzania (1996) and almost 80 percent of such facilities surveyed in Paraguay.[11] Access to clinical methods, such as the IUD and male/female sterilization, is more limited and variable. Only one fifth of Ugandan family planning facilities offer the IUD, compared to 88 percent of Uttar Pradesh facilities. Female sterilization services are usually available in about one-fifth of family planning facilities in any of these country settings. Permanent contraception's availability is proportional to the percent of facilities at the tertiary level in all countries, consistent with the clinical and surgical nature of the procedure. Male sterilization is available less frequently than female sterilization, except in Uttar Pradesh where both are equally accessible.

Antenatal care and immunizations are the next most prevalent type of service, found in 83 to 94 percent of facilities, followed by delivery and postnatal care. Where assessed, child immunization is provided in four fifths or more of facilities in all settings. Nearly all immunization-providing facilities in Tanzania (1996) and Paraguayan facilities had the requisite vaccines (BCG, polio, DPT and measles) on site. Delivery care is available in most Ugandan, Tanzanian and Uttar Pradesh and about half the Paraguayan facilities surveyed. Interestingly in Table 3 the availability of delivery care appears to have an almost inverse relationship with the proportion of mothers using it. About four fifths (82 percent) of Paraguayan mothers deliver in facilities, although less than half of facilities surveyed offer delivery care. Maternity care in Paraguay is likely located in specific clinics or maternity homes which most women use. In contrast only 16 percent of recent births in Uttar Pradesh took place in a health facility although 83 percent of health facilities report providing such services. In Uganda and Tanzania (both rounds) about half of mothers deliver in a facility, and about three-quarters of facilities offer such care. Emergency obstetric care is, not surprisingly, more limited in access with about one third of

[11] The injectable is not an endorsed government method in India and only available through

facilities, many of them tertiary, in Uganda and Uttar Pradesh reportedly equipped with medical personnel, equipment and supplies to manage severe pregnancy complications.

The availability of STD and HIV services is not assessed in every survey; but in Uganda, Tanzania (1996) and Uttar Pradesh, where it is, 78, 91 and 28 percent of facilities respectively report providing such services. In Uganda more facilities offer HIV/AIDS counseling than testing, while in Tanzania 1996 about two thirds offer HIV/AIDS counseling and testing services and only three fifths offer STD diagnosis and counseling.

The average number of health staff varies considerably by type (doctors, nurses and paramedics) and across settings, partially due to the different facility sampling protocols. In Paraguay the average number of doctors at the 144 health facilities is 7.4, the highest among all surveys, with the lowest being 0.5 for Uganda. In Tanzania (both rounds) and Uttar Pradesh, a health facility has on average 1 to 1.5 doctors. There are not necessarily more nurses than doctors (as in Paraguay and Uttar Pradesh) nor more paramedics than either nurses or doctors. The average number of nurses reaches as many as 12.9 in 1996 Tanzanian health facilities[12] and as low as 1.1-1.5 for Uttar Pradesh and Paraguay, while paramedics ranged from 1.7 in Uganda to 6.2-6.7 in Tanzania. Not all are trained in family planning. Among Tanzanian facilities reporting on staff trained in family planning, between 1991 and 1996, we see a moderate increase in the availability of trained doctors and nurses (14.2 to 15.8 percent and 37.1 to 45.1 percent respectively) but a decline in trained paramedics (71.9 to 60.3 percent).

We also calculate the average number of recently stocked out contraceptive and MCH drugs and vaccines, and the percent of facilities reporting a stockout of STD antibiotics/drugs, where the services and data are available. The average number of contraceptives out of stock range from 0.3 to 0.5 in Uganda and Tanzania 1991 to close to 1.0 in Tanzania 1996, Uttar Pradesh and Paraguay. MCH drugs are often not available and to a larger extent than family planning methods. Immunization vaccines similarly tend to be out of stock (0.2 on average in

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private clinics.

Paraugay and 1.0 in Tanzania 1996), although child vaccinations are often administered in camps coordinated by health centers and stockouts may reflect recent camp activity. Recent lack of STD drugs was reported by 30, 52 and 60 percent of Ugandan, Uttar Pradesh and Tanzania (1996) facilities respectively.

Health promotion activities through media, print and interpersonal activities constitute an important health resource component for a national system. Family planning, safe motherhoods, child survival and STD prevention messages are often promoted through health educators, on the radio and in posters and billboards. Tanzania (1996) and Uganda have the highest proportions of facilities reporting outreach activities—66 and 73 percent respectively, with Paraguayan facilities near the same level for family planning promotion. Facilities in Uttar Pradesh and Tanzania 1991 report levels closer to 40 percent. Nearly all of the 52 Paraguayan facilities that conduct health education activity report having MCH posters.

The profile of the supply of reproductive and child health resources obtained from Table 5 confirms this study is addressing a range of health delivery systems operating in low-income settings, primarily under government sponsorship and with variable efforts expended toward family planning, reproductive and sexual health care. Drug supply procurement and distribution do not function adequately. At the same time individual utilization levels are higher than expected for some services, given their availability. It is to the relationship between local access and individual use that we now turn.

Individual- and system-level determinants of service use. Our multi-level multivariate analysis begins with logit regressions of the service use outcomes on individual-level determinants, the results of which are presented in Appendix tables 1a to 1e. These correspond to the country survey order of Paraguay, Uganda, Tanzania 1991, Tanzania 1996, and Uttar Pradesh, India, respectively. We then estimate a second regression model of the services outcomes on the health system resource variables and the individual-level predictors. The results are presented in

[12] One or two large hospitals included in the sample have very large staffing.

Appendix tables 2a to 2e again following the same country survey order. Table 6 provides a summary overview of the statistically significant parameters in the two models. A "+" or "-" signifies a positive or negative association with a significance level of $p<.10$ or better (based on a one-tailed test). A "U" signifies a concave curvilinear association, while a "-U" indicates a convex-shaped association across the predictor categories.

Table 6. Summary of statistically significant parameters for individual and facility-level determinants of contraceptive, maternity and sexual health service use

	Modern method use		Clinical method use		Trained ANC provider		Trained delivery attendant		Facility-based delivery			
Variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Paraguay												
Age	-	-	+	+	NA		+				NA	
Education			+	+			+		+	+		
Urban residence		-					+		+			
Children ever born	+	+	+	+								
HH electricity	+	+	+	+					+			
HH assets	+	+								+		
Message exposure	--- na ---		--- na ---				--- na ---		--- na ---			
Facility type												
Government authority	--- na ---		--- na ---				--- na ---		--- na ---			
Health staff												
FP doctors		+										
FP paramedics												
FP methods		+		+								
Stockout in drugs										-		
MCH services (a)								+		U		
Outreach								+				
Distance to nearest HF		+						-		-		
Uganda												
Age	-U		+								+	+

Education	+				+		+		+	+	+	+
Urban residence	+				+		+		+	+	+	+
Children ever born	+		+						+		~	~
HH electricity	--- na ---		--- na ---		--- na ---		--- na ---		--- na ---		--- na ---	
HH assets	--- na ---		--- na ---		--- na ---		--- na ---		--- na ---		--- na ---	
Message exposure		+				+		+		+		+
Facility type												
Government authority		+										
Health staff												-
FP doctors		-										
FP paramedics												
Methods/services												
Stockout in drugs		-										
Outreach												-
Distance to nearest HF						-		-		-		-
Tanzania 1991												
Age	-U	-U			+	+	+	+	+	+	NA	
Education	+	+			+	+	+	+	+	+		
Urban residence	+	+	-		+	+	+	+	+	+		
Children ever born	+	+	U		-	-	-	-	-	-		
HH electricity	+	+			+	+	+	+	+	+		
HH assets	+	+			+	+	+	+	+	+		
Message exposure												
Facility type		-		U						-		
Government authority		-		-		-		-		-		
Health staff												
FP doctors												
FP paramedics												
Methods/services						+		+		+		

Stockout in drugs						+						
Outreach		+						+		+		
Distance to nearest HF				+				-		-		
Tanzania 1996												
Age	-	-					+	+	+	+	-U	-U
Education	+	+	+		+	+	+	+	+	+	+	+
Urban residence	+	+		-	+	+	+	+	+	+	+	
Children ever born	+	+					-	-	-	-	-	-
HH electricity	+	+	+					+	+	+	+	+
HH assets	+		+	+	+		+	+	+	+		
Message exposure		-										+
Facility type		-		-U				~				
Government authority		-						-		-		-
Health staff												
FP doctors												
FP paramedics		+										
Methods/services				+				+		+		-
Stockout in drugs				-								
Outreach				-				-				
Distance to nearest HF		-		-				-		-		
Uttar Pradesh, India												
Age	+	+	+	+			+		+	+	NA	
Education	+	+	-	-	+	+	+	+	+	+		
Urban residence	+	-	-	-	+		+	+	+			
Children ever born	-U	-U	-U	-U		-	-	-	-	-		
HH electricity	+	+			+	+		+				
HH assets	+	+	-		+	+		+	+	+		
Message exposure		+		-								
Facility type		+				+		+				

Government authority		-				-		-		
Health staff				-		+		+		+
FP doctors		+		+						
FP paramedics		-		+						
Methods/services				-						
Stockout in drugs		+								
Outreach								+		
Distance to nearest HF	--- na ---		--- na ---		--- na -- -		--- na -- -		--- na -- -	

(a) Access to MCH services at nearest primary level unit										
Model I is of individual-level social, demographic and economic determinants										
Model II is of both individual-level and health system-level resource determinants										
Key: Direction of effects, significant at p <.10 level or better										
+ = positive										
- = negative										
U = nonlinear U-shaped pattern										
-U = nonlinear, inverted U-shaped										
~ = nonlinear, indeterminate-shaped pattern										

Table 7 presents the F statistics from the adjusted Wald tests of the joint hypothesis, i.e., the independent contribution of the health system resources to explaining individual utilization of services.

With the modeling results, we estimate an individual woman's probability of using the family planning/reproductive health services for specific values of the significant health system predictors. This predicted use outcome is estimated keeping the woman's values on the other predictors in the multilevel model unchanged. The predicted probabilities averaged across women are graphed in Figures 3 to 7 and illustrate the potential and net impact of the different types of program resources across the countries, from the estimated models. That is, the effects of all other predictors in the models are held constant. We discuss these results in detail next.

Table 7. Regression model statistics (F statistic) on variable groups and test of joint significance of health facility variables: Paraguay, Uganda, Tanzania (1991 and 1996) and Uttar Pradesh

Table cells contain the F statistic (row 1), degrees of freedom (row 2) and p-value (row 3).

	Paraguay 1998					
Variable groups	MM	CMU	ANC	DEL ATT	DEL PLC	HIV TST
Individual and household attributes (A)	21.78 13, 94 .000	4.86 13, 93 .000	na	5.20 13, 56 .000	7.63 13, 56 .000	na
FP/RH message exposure (B)	na	na	na	na	na	na
Health facility factors (C)	2.25 10, 97 .021	1.32 10, 96 .230	na	8.02 10, 59 .000	7.39 10, 59 .000	na
A+B	na	na	na	na	na	na
A+C	12.68 23, 84 .000	3.58 23, 83 .000	na	6.95 23, 46 .000	6.59 23, 46 .000	na
Adjusted Wald test for C						
F	3.13	1.45	na	3.72	3.74	na
df	10, 97	10, 96		10, 59	10, 59	
p value	0.002	0.170		0.002	0.001	

	Uganda 1997					
Variable groups	MM	CMU	ANC	DEL ATT	DEL PLC	HIV TST
Individual and household attributes (A)	9.65 11, 61 .000	4.44 11, 53 .000	4.93 11, 61 .000	16.23 16, 23 .000	13.25 11,61 .000	8.08 19, 53 .000
FP/RH message exposure (B)	11.81 2. 70 .000	1.19 2, 62 .312	13.70 2, 70 .000	12.85 2, 70 .000	11.20 2, 70 .000	6.93 2, 70 .002
Health facility factors (C)	4.43 9, 63 .000	1.47 9, 55 .183	11.03 8, 64 .000	5.69 8, 64 .000	4.40 8, 64 .000	5.17 8, 64 .000
A+B	7.45 20, 52 .000	2.93 20, 44 .002	7.05 19, 53 .000	9.87 19, 53 .000	7.40 19, 53 .000	4.78 19, 53 .000
A+B+C	7.35 20, 52 .000	2.90 22, 42 .002	8.32 21, 51 .000	8.64 21, 51 .000	6.49 21, 51 .000	4.92 21, 51 .000
Adjusted Wald test for C						
F	2.51	1.22	4.16	1.71	1.46	2.32
df	9 ,63	9, 55	8, 64	8, 64	8, 64	21, 51
p value	0.016	0.305	0.001	0.113	0.190	0.030

	Tanzania 1991					
	MM	CMU	ANC	DEL ATT	DEL PLC	HIV TST
Individual and household attributes (A)	24.90 14, 304 .000	256.22 13, 173 .000	9.64 14, 304 .000	20.62 14, 304 .000	19.17 14, 304 .000	na
FP/RH message exposure (B)	na	na	na	na	na	
Health facility factors (C)	10.04 13, 305 .000	1.82 13, 173 .043	10.26 10, 308 .000	15.79 10, 308 .000		14.72 10, 308 .000
A+B	na	na	na	na	na	
A+C	13.47 27, 291 .000	754.89 27, 159 .000	8.74 24, 294 .000	16.15 24, 294 .000		13.19 24, 294 .000
Adjusted Wald test for C						
F	3.66	1.21	6.60	11.91	9.00	
df	13, 305	13, 173	10, 308	10, 308	10, 308	
p value	0.000	0.279	0.000	0.000	0.000	

	Tanzania 1996					
	MM	CMU	ANC	DEL ATT	DEL PLC	HIV TST
Individual and household attributes (A)	33.28 14, 312 .000	9.62 14, 224 .000	8.25 14, 309 .000	22.07 14, 309 .000	19.58 14, 309 .000	10.93 14, 312 .000
FP/RH message exposure (B)	101.10 2, 324 .000	1.70 2. 236 .184	na	na	na	25.70 2, 324 .000
Health facility factors (C)	10.37 13, 313 .000	3.57 13, 225 .000	17.55 11, 312 .000	11.83 11, 312 .000	7.35 11, 312 .000	8.92 11, 315 .000
A+B	19.35 27, 299 .000	8.01 27, 211 .000	na	na	na	9.40 25, 301 .000
A+B+C	19.24 29, 297 .000	7.50 29, 209 .000	9.48 25, 298 .000	14.17 25, 298 .000	13.46 25, 298 .000	8.65 27, 299 .000
Adjusted Wald test for C						
F	1.91	3.54	5.30	5.67	3.16	2.32
df	13, 313	13, 225	11, 312	11, 312	11, 312	11, 315
p value	0.028	0.000	0.000	0.000	0.001	0.010

	Uttar Pradesh 1995					
	MM	CMU	ANC	DEL ATT	DEL PLC	HIV TST
Individual and household attributes (A)	299.18 14, 2248 .000	110.40 14, 2108 .000	24.40 14, 395 .000	26.90 14, 395 .000	27.92 14, 395 .000	na
FP/RH message exposure (B)	486.08 2, 2260 .000	135.02 2, 2120 .000	na	na	na	
Health facility factors (C)	42.38 14, 2248 .000	14.85 14, 2108 .000	17.65 9, 400 .000	15.81 9, 400 .000		21.57 9, 400 .000
A+B	154.70 28, 2234 .000	55.63 28, 2094 .000	na	na	na	
A+B+C	150.62 30, 2232 .000	50.98 30, 2092 .000	17.64 23, 386 .000	18.14 23, 386 .000		19.48 23, 386 .000
Adjusted Wald test for C						
F	4.36	3.46	7.99	3.04	2.20	
df	14, 2248	14, 2108	9, 400	9, 400	9, 400	

p value	0.000	0.000	0.000	0.002	0.021

Notes: F statistic for Wald test is highlighted if p value is < .05.
MM = Modern method use; CMU = Clinical method use (among users); ANC = Trained ANC provider;
DEL ATT =Trained attendant at delivery; DEL PLC = Facility-based delivery;
HIV TST = Ever tested for HIV/AIDS.

In testing the joint significance of health facility variables, shown in Table 7, we find we are able to reject the null hypothesis and accept their independent and significant contribution. Only in predicting the probability of using a clinical method, among contraceptors in Paraguay, Uganda and Tanzania 1991, do health service resources not significantly add to the explanation obtained from individual-level predictors. Quite possibly health system resources in Paraguay are sufficiently accessible so as not to influence a woman's use of clinical contraception (IUD and sterilization) significantly; also the level of clinical method use in Uganda and Tanzania, unlike India, may be sufficiently low as to be insensitive to existing system inputs. Clinical method choices by users, as well, may predate the access and quality of services measured at the time of the surveys. Health system resources do not contribute statistically to the prediction of facility-based delivery or trained birth attendant use in Uganda either. Apart from these five utilization models, the local resource environment for health care as a whole occupies an important predictive role for all 21 other utilization outcomes modeled.

The regression parameters and standard errors for specific individual- and system-level influences are presented as odds ratios (ORs) and their 95% confidence intervals in Appendix tables 1a-1e and 2a-2e. These are summarized in Table 6. From Appendix tables 1a-1e we see that the woman's age tends have a stronger (positive) influence on her contraceptive practice than on her use of maternity care. In Paraguay the age pattern for modern method use is reversed, with younger women more likely to practice modern contraception and older women more likely to practice clinical methods. In Uganda, the age pattern is curvilinear, with the highest odds ratios found for women 25 to 34 years of age. Older women are more likely than the youngest group to have had an HIV/AIDS test in Uganda and Tanzania (1996).

Parity tends to positively influence a woman's contraceptive practice and negatively influence her maternity care use. In Tanzania 1996 and Uttar Pradesh parity does not appear to influence antenatal care use in a statistically significant manner nor a woman's likelihood of maternity services use in Paraguay. The socioeconomic factors of education, urban residence, household electricity and household assets are for the most part predictive of service use outcomes at significant levels across the surveys. Since many of the surveys were conducted in low-income areas or countries, it is not surprising to find high ORs associated with better education, urban residence, presence of household electricity or possession of a large number of household assets. For instance, the ORs associated with using modern contraception, antenatal or maternity services are higher if the woman has a primary or secondary, as opposed to no, education. In the very low-income countries (all but Paraguay), we see high ORs for maternity care associated with the socioeconomic factors, suggesting that use of formal health services for pregnancy and delivery is strongly influenced by household economic resources. Interestingly the ORs estimated for urban residence in the clinical contraception use model are negative, meaning that urban contraceptors are less likely to use clinical methods. This is consistent with the long-acting nature of clinical methods for which rural women may be more motivated to reduce their time costs when seeking contraception.

The two rounds of Tanzania data and identically specified individual-level models allow us to observe trends between 1991 and 1996 in the ORs for the demographic and socioeconomic determinants. In general the parameters in the contraceptive behavior models are smaller in magnitude in 1996 than 1991, suggesting that access to services may have expanded to reach a broader segment of the client population or that personal motivations to use services have diffused across the client population, mitigating the effect of socioeconomic and demographic differences. Some exceptions are the effects of urban residence and the highest education category, which for almost all use outcomes are stronger in 1996 than 1991.

The inclusion of the health system variables (Model 2, as seen in Table 6) does not much alter the patterns of association for the individual predictors (Model 1) across the outcomes and surveys--virtually all parameters retain the same direction of effects in Model 2 as in Model 1. This confirms the added information from and predictive value of local health resources. We can look at some of the latter's effects graphically in Figures 3 to 7. In Figure 3 we have estimated the proportion of women using a particular service at specific distances to the nearest health facility (or facility type) for countries where a statistically significant distance effect was assessed (excluding Uttar Pradesh where distance was not measured). There is a relatively clear pattern of distance decay effects. In Paraguay, the distance decay in use of facility-based delivery care is stronger than for use of modern contraception. Similarly, having a facility-based delivery and having a trained attendant at birth are both sensitive to distance to the nearest facility in Paraguay, Uganda, and both rounds in Tanzania. It is not surprising to observe stronger distance decay effects for maternity care, as opposed to those associated with contraceptive or HIV care, given the immediacy of needs at the time of birthing.

Figure 4 provides the predicted proportions using the services when specific numbers of contraceptive methods or MCH services are available at the facilities proximate to the respondent's cluster. The response pattern is positive in Tanzania 1991 and 1996 and for contraceptive method use in Paraguay. It is negative for maternity service use in Paraguay, as well as in Uttar Pradesh (for contraceptive method use) and Uganda (for trained attendant at delivery), although the latter two are not statistically significant (nor shown here). While predicted levels of contraceptive and maternity care use increase almost two-fold when the number of methods or services in a facility shift from 0-1 to 5-6, those for HIV testing (in Tanzania 1996) do not change appreciably.

The public sector is often the principal source of accessible health care in low-income countries, such as Uganda, Tanzania and northern India. Figure 5 illustrates the net effect of having one or more proximate health facilities operated by the government in Uganda, Uttar

Pradesh and Tanzania (both rounds). The association was not significant in Paraguay, possibly because the majority of facilities in the sample belong to the government. In Uganda, the percent of women using modern contraception is 6 percentage points higher and the percent of recent mothers having a facility-based delivery or a trained birth attendant is 10 points higher if the nearby facility is a government one. On the other hand in Uttar Pradesh and Tanzania, as the density of government facilities increases, the association with contraceptive or maternity care use is increasingly negative. The effect of density of government facilities is also negative, but not appreciably so, for HIV testing in Tanzania (1996) and for modern contraceptive use in Uttar Pradesh. This anomaly may reflect *a priori* targeting to site government services in areas perceived to have high need for such care.

Because commodity stocks are essential for service provision, stockout situations signal inadequate supply and services, whether because client demand has recently exceeded the available inventory or the drug and supply procurement and logistics system have malfunctioned. In Figure 6 we see both types of possible outcomes for stockouts of contraceptive methods or MCH drugs and supplies. Statistically significant negative effects are observed for women's use of modern contraception in Uganda, Tanzania (1991) and Uttar Pradesh and having facility-based deliveries in Paraguay. In Tanzania (1996) predicted levels of clinical method use decline from 21 to 11 percent as the number of stocked-out methods increases from 0 to 4. In Uttar Pradesh, where sterilization predominates, the decline is very marginal (from 78 to 75 percent) with the incremental absence of contraceptive stocks. In Paraguay the direction of association between MCH drugs/supply stockout and facility-based care is positive, with higher levels of delivery use where more MCH drugs and supplies are reported to be out of stock at the time of the survey. The graphs illustrate the two types of associations possible between service utilization and having inadequate medical and heath commodities on site.

The third of Roemer's resource components is health knowledge, and we observe in Figure 7 the relationship between facility outreach activities or message exposure and individual

use of services. Health education outreach activities are measured in terms of whether the proximate facilities conduct any or none. An individual woman's exposure to a health messages through media channels is measured in terms of having no exposure, exposure through electronic and/or print, or exposure through print channels only. Significant associations with contraceptive, maternity and sexual health care are observed in Uganda and both survey rounds in Tanzania. Electronic media tend to be most effective in disseminating health messages, judged by the magnitude of the predicted use levels for contraceptive and maternity care in all settings. Predicted levels of antenatal care use, observed at 83 percent overall, can reach 87 percent if all women had reported hearing or seeing antenatal care messages on the radio or TV and as low as 74 percent in the absence of such exposure. Similarly in Tanzania (1996) modern contraceptive use levels can reach 16 percent if all women reported exposure to family planning messages through electronic media as compared to 7 percent in the absence of exposure. Because self-reported message exposure can be endogenously determined, i.e., explained by other individual-level factors, we also look to the influence of objectively measured outreach activities on individual consumption of services. In Tanzania (1991) the predicted use of facility-based delivery care by recent mothers is 38 percent if all local facilities conducted no outreach activities, as compared to 53 percent if all did. System-level activities to disseminate health information and increase health knowledge are then associated with higher levels of service use in Tanzania (both rounds).

With respect to the fourth health system resource--health staff--the patterns of association with the various use outcomes are equivocal at best (and thus not presented graphically). In some cases, the measures of the numbers of trained providers in the community, either for general health or family planning, show a statistically significant (and positive) net association with modern contraceptive use, in Paraguay, Tanzania (1996) and Uttar Pradesh. In most cases, however, the odds ratios associated with trained provider measures are not significantly different from 1.0. Why the community-level supply of health staff shows little empirical association is

worth further investigation. It is possible that the numbers of staff summed across facilities linked to a woman's community is disproportionately high in urban areas, masking any statistically significant association.

Discussion

This study attempts to assess empirically the association between health program factors at the community level and an individual woman's consumption of health services, using multilevel data from five sample surveys of health facilities and individual females of childbearing age conducted in four developing countries -- Paraguay (1998) , Uganda (1997), Tanzania (1991 and 1996) and northern India (1995-96). By studying the associations at the community or cluster level, we have a more direct opportunity to detect individual behavioral responses to the distribution, composition and quality of health resources in the local environment than if we attempted to link national-level inputs with such behaviors. We have also focused on measures of women's use of family planning and other reproductive health services, albeit those for sexual health care have necessarily been limited to HIV testing due to very low reported levels of STD care. The selected modern and clinical contraceptive, maternity, and sexual health services reflect those defined as integral to a comprehensive package of reproductive health care, despite being primarily oriented toward female consumers.

This study seeks out patterns of effects from individual- and health system-level determinants in 26 different models of health service use across the five surveys. The individual-level factors are social, economic and demographic in nature, e.g., education, urban residence, household wealth, parity, and age. The results from modeling use outcomes, when restricted to just these determinants, confirm the latter's well-established influences on health care-seeking behavior. While the direction of the demographic variables' effects may vary whether the service use outcome is for contraceptive, maternity or sexual health care, those for socioeconomic status

consistently predict more service use with improved circumstances. In these low-income settings, the actual receipt of formal reproductive health care appears to be very dependent on household or personal resources.

In the 26 service utilization models, only 5 did not show a statistically significant contribution from the inclusion of health program resources. Most of these outcomes are related to clinical contraceptive use, an infrequent behavior in the "failed" models. More notably, the size and direction of the regression parameters for the individual-level predictors did not change appreciably in the model after the addition of health facility-level predictors. On the basis of the joint hypotheses tests, we can reject in a majority of the cases the null hypothesis that the effect of health system resources on individual service use is zero. In examining specific pathways by which health resources in the woman's local environment might influence her use of family planning/reproductive health care, we test measures of Roemer's (1991) four components--health facilities (physical distance to, density and type of facilities), manpower (number and types of health providers), commodities (range of services, stockout of needed drugs and supplies) and knowledge (outreach and promotional activities). Among all the resource measures, only manpower did not consistently show a net influence on the probability of a woman using reproductive health services. The strongest independent associations between individual use and health resources were distance decay effects, particularly for distance from the proximate health facilities and use of maternity care services. Linear increases in use with the number of services or methods provided were also observed. On the other hand, a high density of public sector facilities in the area was actually associated with declining family planning/reproductive health service use, perhaps the result of program targeting. Commodity stock out situations also had a relatively modest impact on use in either a positive or negative direction. Last, educational outreach or promotion activities to expand health knowledge did independently influence health care use in a positive manner. In sum, this comparative multilevel analysis has found evidence of independent and important influences from health system-level resources on the probability of an

individual woman's utilization of key family planning and reproductive health services. Establishing this path of association is requisite to any subsequent evaluation of the overall impact of health system resources on variations in individual health outcomes.

In our effort to contribute to the knowledge base of health resource effects on service utilization, we have adopted a health systems framework with a strong supply-side orientation (Roemer, 1991; WHO, 2000). The framework's adoption supplements and enhances the findings from other research that has focused on causal pathways between individual or household attributes and health care-seeking behaviors (e.g., Murray and Lopez, 1997) by instead identifying intermediate causal pathways linking health system inputs with the **use** of health services. The research literature of the past decade on health system or resource effects has been equivocal regarding the role of health resource production, likely reflecting, as noted in the beginning, inadequate measurement and data systems. By capitalizing on recently collected health facility survey data, we can link the records of facilities common to a community or cluster to individual respondents' records from the same communities or clusters. This areal relationship enables us to explore whatever connections may exist between the access, quality and outreach of the health resources in the local environment and resident individuals' consumption of the services provided. While we do not assume that individuals use exactly the services available from proximate facilities, we do assume that such cluster sampling of communities and residents, replicated often enough in a given survey, offers repeated observations with which to assess, using appropriate statistical methodology, the resource-behavioral linkages of interest.

The quality of health services in these four low-income countries being what they are enjoin us from making too many programmatic or policy recommendations based on the relative effectiveness observed for the different resource components. The contraceptive and other reproductive health services are delivered by the same health infrastructure that also delivers services for infectious disease, environmental sanitation, curative care or over-the-counter medication. Thus we risk over-interpreting the findings if we focus too heavily on the relative

influences of the health system components. Although we observe stronger effects related to physical access to health facilities, for example, it does not necessarily follow that resources to improve service delivery should be allocated to construct facilities nearer to populations at the expense of improving drug commodity distribution systems or health manpower development. The findings here suggest generally that resource investments in the main system components will appreciably raise the level of service utilization, independent of that possible from personal or household resources alone. In turn, increased use would result, *ceteris paribus*, in improved health status.

A principal weakness of this study is its cross-sectional nature, dictated by the longstanding absence of appropriate longitudinal data on health resources at the community and individual levels. This deficit will hopefully be corrected with time and sustained investments to improve the accuracy, quality and coverage of local health information systems. We also believe further study of the forces driving the market ecology of health resources is warranted. Factors that determine the supply of health services may operate in some rational market-driven manner, by responding to consumer preferences and locating services conveniently. This market may not necessarily mean an equitable distribution accessible to all consumers, such as those in rural areas (see Haaga and Tsui, 1995). While public health services are more likely to be sited using concerns about access equity, e.g., with rural health units, they also tend to be plentiful in urban areas because formal bureaucracies favor functional replication (such as contraceptive service provision through government hospitals, government maternity care units, or government pharmacies). Whatever externalities drive the formation and distribution of units for health resource production, the latter cumulate in a measurable density of private, as well as public, health care providers, for a given area, thereby defining a market ecology. In this ecology of health care multiple providers voluntarily and visibly cluster in small towns and urban cities drawing in clients for intermittent or frequent care.

Our study, along with others, suggest that a comprehensive and thorough understanding of the dynamics of health systems in developing countries and of the definitive impact their resources have on individual health will require data systems that are not yet in place. A second methodological limitation of the study is the varying coverage of health facilities due to different sampling procedures. In the future, censuses of health establishments will be important for accurate characterization of the health service infrastructure and the market of provider choice offered to consumers with significant health needs. The development of health establishment censuses, as well as their regularly repeated execution, will enable the construction of organizational "health" profiles that, along with health expenditure data, can then be linked to and correlated over time with individual health and health care behaviors. This capability will be essential whether the analytic purpose is to examine resource impact on population-based communicable or chronic disease patterns or clients' use of preventive care, such as family planning and other reproductive health services.

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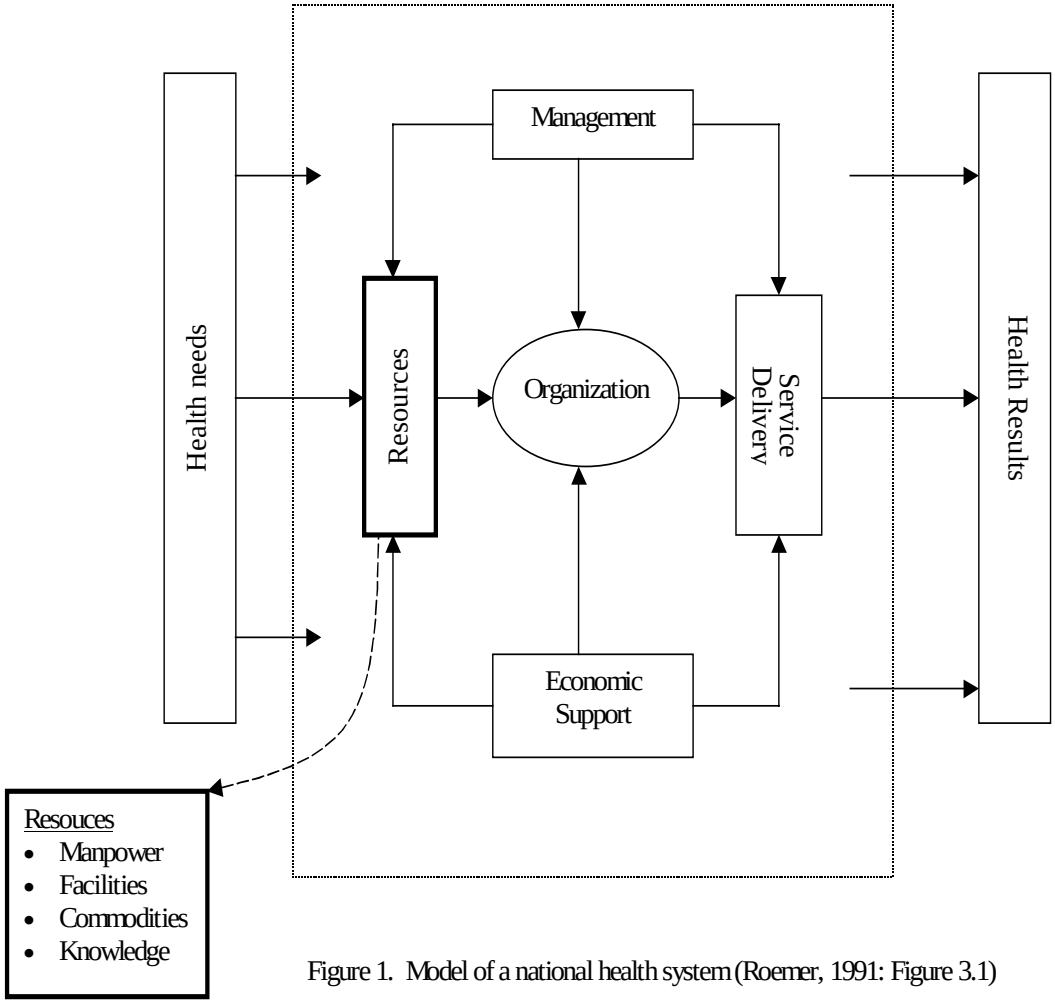


Figure 1. Model of a national health system (Roemer, 1991: Figure 3.1)

Figure 2. Levels of Family Planning, Sexual and Reproductive Health Service Use in Paraguay, Uganda, Tanzania (1991 and 1996) and Uttar Pradesh, India

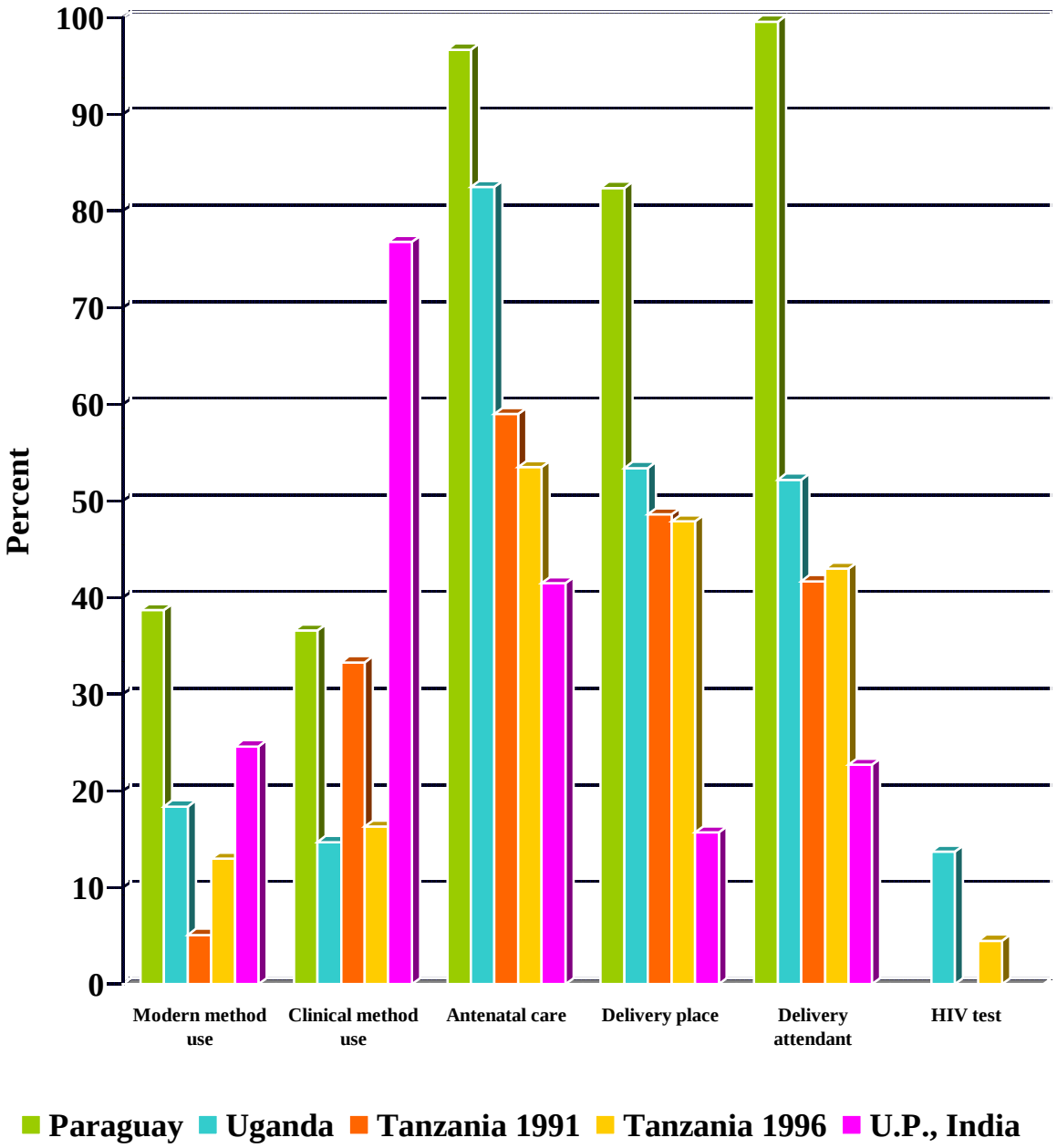


Figure 3. Predicted proportions of women/recent mothers using FP/RH services at selected distances from the nearest health facility from four surveys

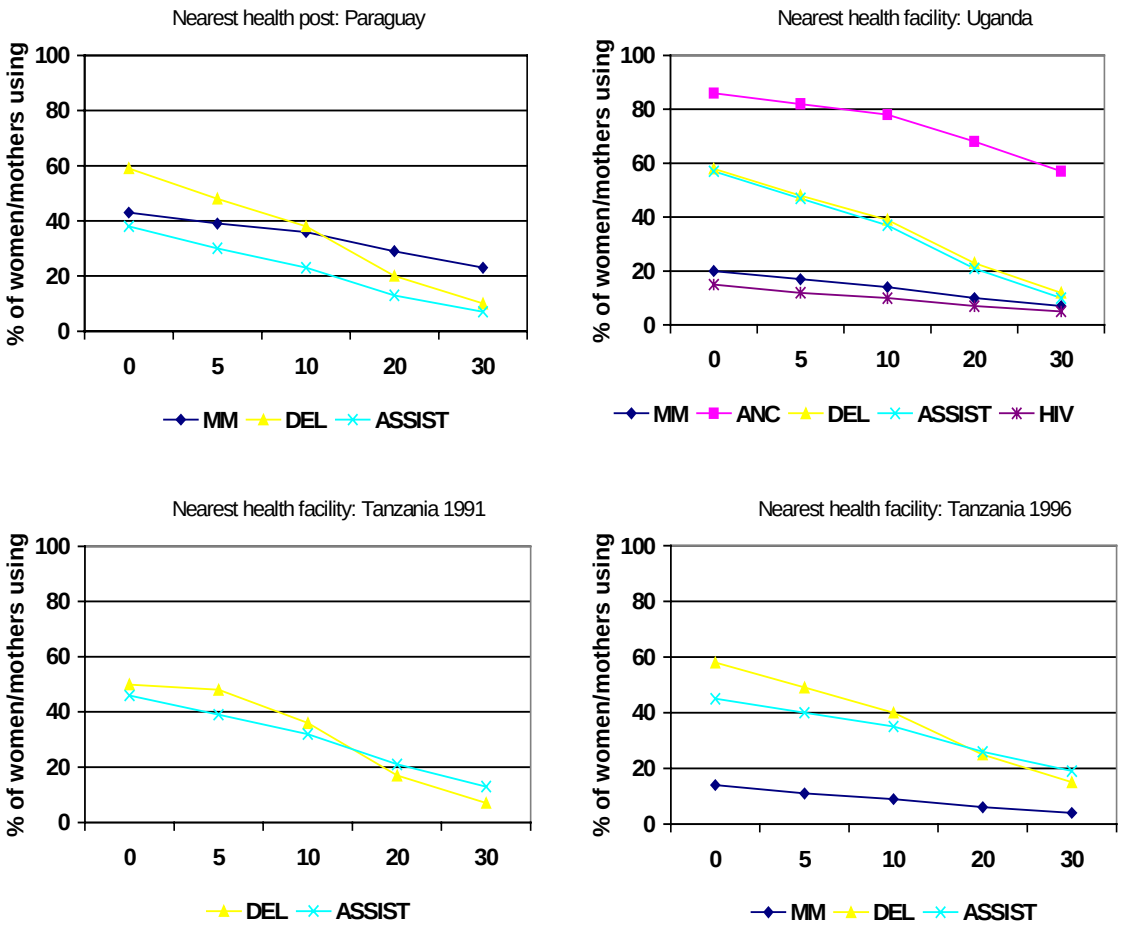


Figure 4. Predicted proportions of women/recent mothers using FP/RH services by number of FP methods or MCH services provided, across three surveys

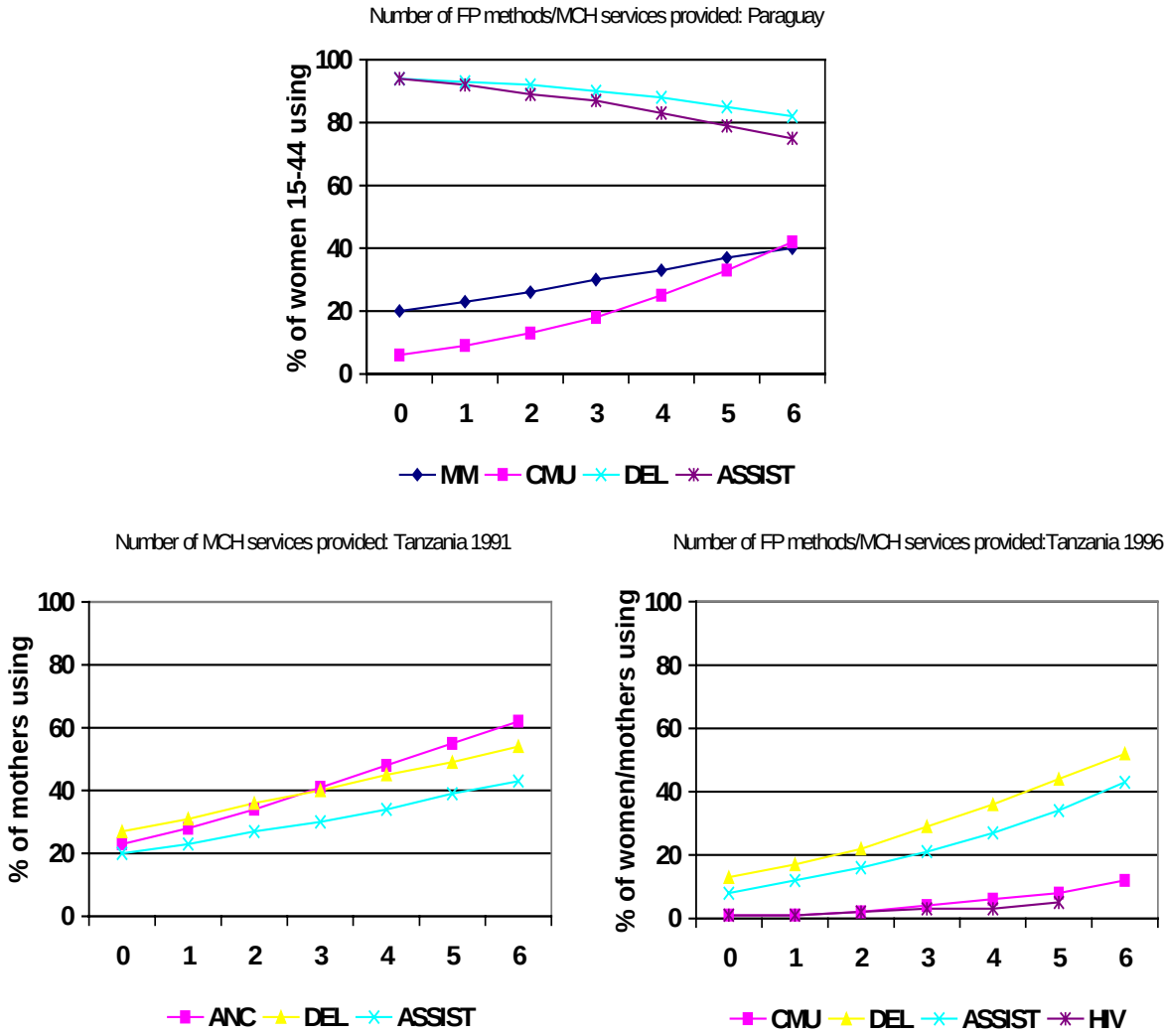


Figure 5. Predicted proportions of women/recent mothers using FP/RH services by whether at least one (or number of) government health facility in/near cluster, across three surveys

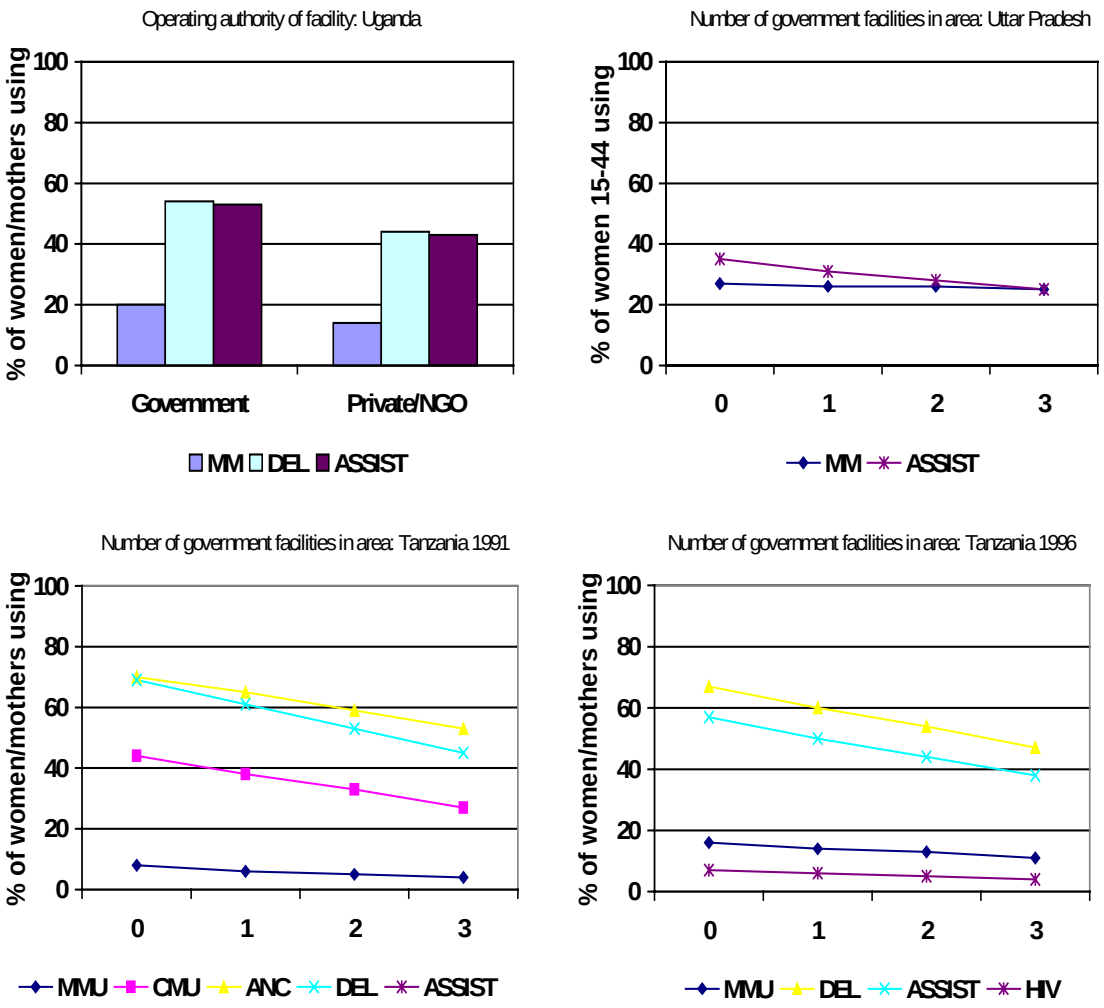
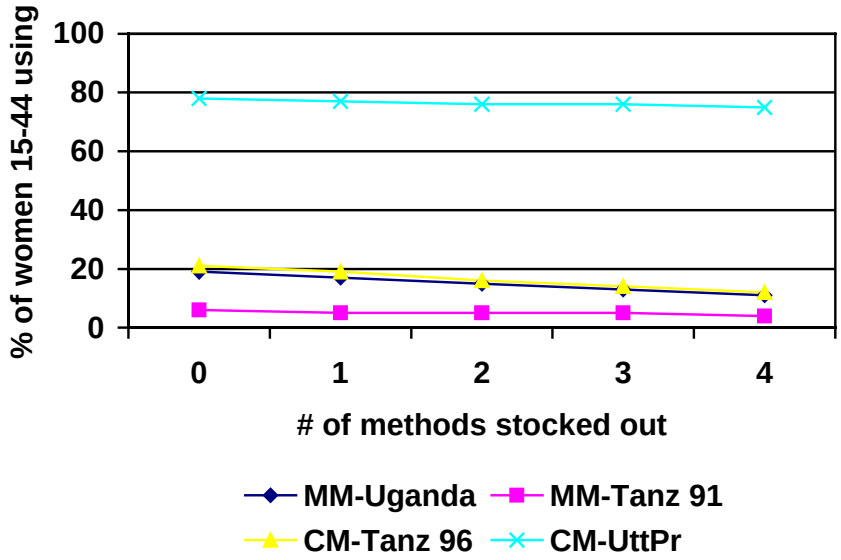


Figure 6. Predicted proportions of women/recent mothers using FP/RH services by number of FP or MCH commodities out of stock, across surveys



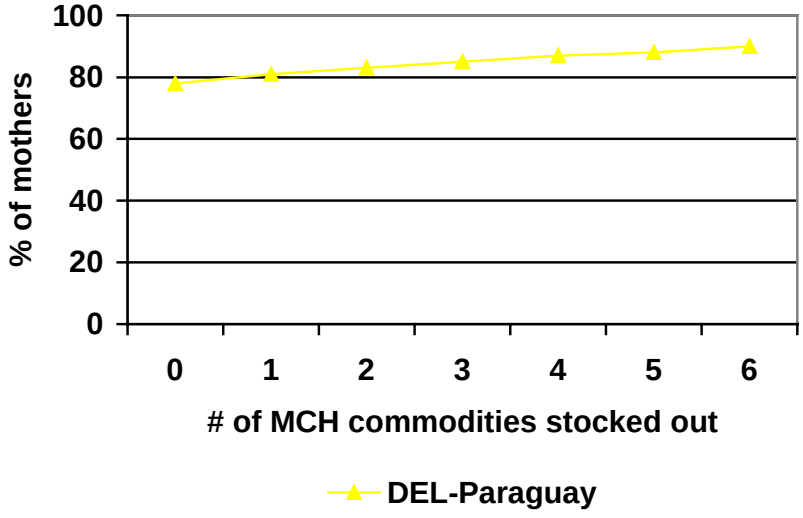


Figure 7. Predicted proportions of women/recent mothers using FP/RH services by type of media exposure for health message and any facility outreach activity, across four surveys

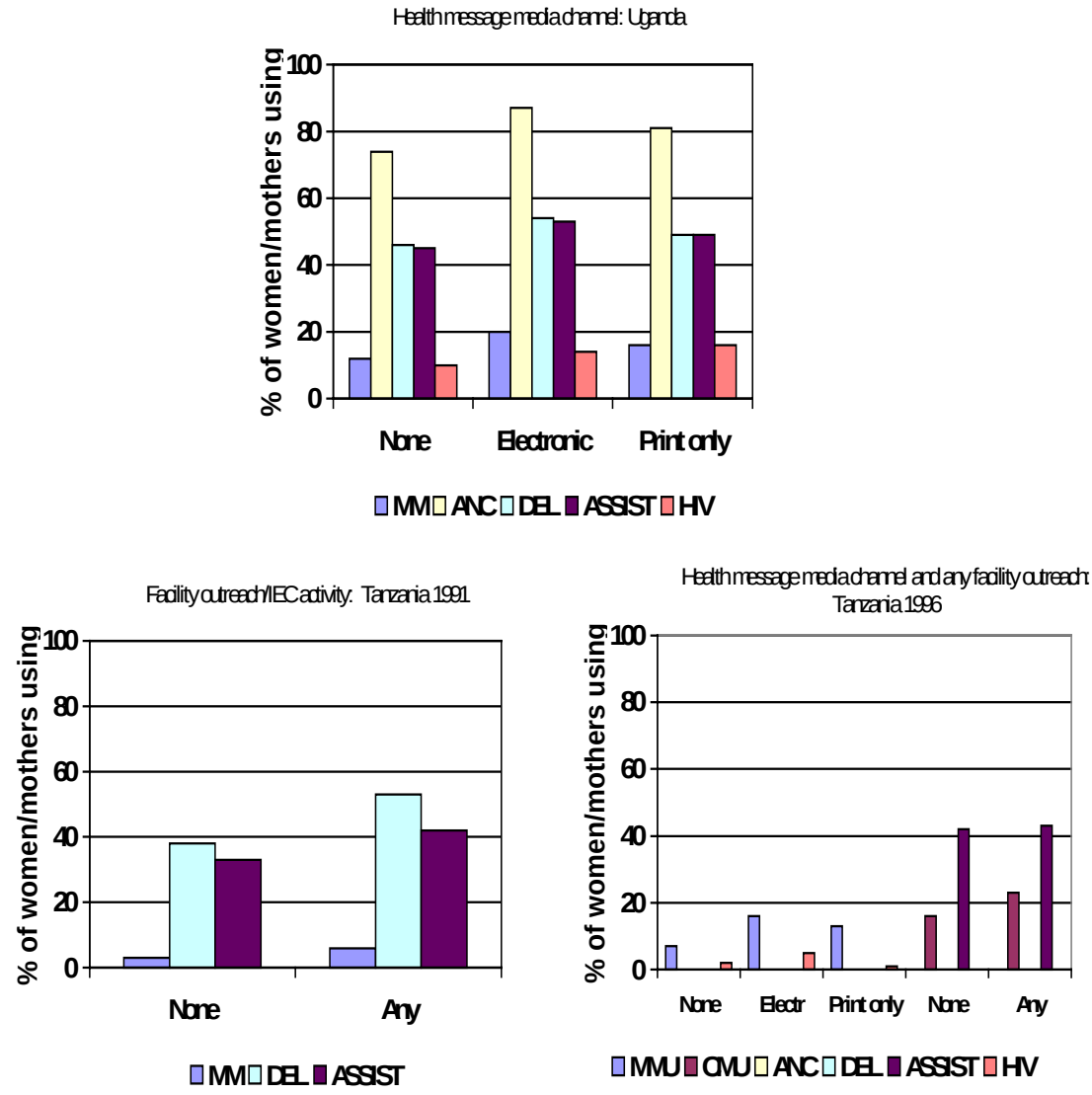


Table 1a. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected individual determinants: Paraguay 1998

Variable	Modern method use		Clinical method use		Had trained ANC provider for last birth		Had trained delivery attendant at last birth		Last delivery was facility-based	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
n	2049		785				722		722	
F	2.25		4.86		Outcome nearly universal;		5.2		7.63	
df	(10, 97)		(13, 93)		determinants not		(13, 56)		(13, 56)	
p	0.021		0.000		modelled.		0.000		0.000	
Woman's age										
15-19	ref		ref				ref		ref	
20-24	5.71	(3.84, 8.51)	3.54	(0.72, 17.32)			0.41	(0.17, 0.99)	0.71	(0.24, 2.13)
25-29	4.51	(2.89, 7.04)	8.85	(2.11, 37.18)			0.47	(0.18, 1.20)	0.7	(0.20, 2.46)
30-34	3.65	(2.32, 5.76)	5.90	(1.26, 27.59)			0.62	(0.23, 1.70)	0.72	(0.21, 2.47)
35-39	4.83	(2.93, 7.96)	9.03	(2.03, 40.24)			0.62	(0.23, 1.64)	0.55	(0.17, 1.77)
40+	3.08	(1.79, 5.33)	14.16	(3.12, 64.22)			0.80	(0.22, 2.93)	0.74	(0.16, 3.36)
Woman's education										
None	ref		ref				ref		ref	
Any primary	ref		ref				ref		ref	
Any secondary	1.12	(0.85, 1.46)	1.44	(1.03, 2.01)			3.09	(1.98, 4.81)	3.00	(1.63, 5.55)
Urban residence	0.84	(0.64, 1.08)	0.77	(0.53, 1.19)			2.57	(1.37, 4.83)	1.72	(1.06, 2.79)
# of children ever born										
0-1	ref		ref				ref		ref	
2-3	3.34	(2.43, 4.57)	1.67	(1.09, 2.56)			1.17	(0.68, 2.03)	0.73	(0.36, 1.47)
4-6	3.59	(2.44, 5.29)	1.84	(1.20, 2.83)			0.98	(0.51, 1.89)	0.60	(0.26, 1.39)
7+	4.06	(2.45, 6.74)	2.02	(1.08, 3.77)			0.50	(0.21, 1.22)	0.41	(0.14, 1.20)
HH has electricity	1.69	(0.95, 3.03)	3.13	(1.32, 7.45)			1.28	(0.53, 3.04)	1.50	(0.61, 3.65)
Household assets										
Low	ref		ref				ref		ref	
Medium	1.89	(1.33, 2.69)	1.45	(0.69, 3.05)			1.04	(0.48, 2.25)	1.52	(0.76, 3.03)
High	2.26	(1.56, 3.27)	1.51	(0.73, 3.11)			1.52	(0.68, 3.39)	2.37	(1.13, 4.94)

Regression coefficients are adjusted for multi-stage cluster design effects
Highlighted odds ratios are statistically significant at p< .10 or better level (one-tailed test)

Table 1b. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected individual determinants: Uganda 1997

Variable	Modern method use		Clinical method use		Had trained ANC provider at last birth		Had trained delivery attendant at last birth		Had facility-based delivery		Ever had HIV test	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI	OR	95% CI
n	1680		311		1224		1224		1224		1672	
F	9.65		4.44		4.93		13.25		16.23		8.08	
df	(11,61)		(11,53)		(11,61)		(11,61)		(11,61)		(11,61)	
p	0.000		0.000		0.000		0.000		0.000		0.000	
Woman's age												
15-19	ref		ref		ref		ref		ref		ref	
20-24	1.46	(0.94, 2.25)	0.42	(0.07, 2.49)	0.67	(0.32, 1.42)	0.91	(0.55, 1.51)	0.87	(.54, 1.38)	1.48	(0.88, 2.49)
25-29	2.14	(1.39, 3.28)	1.42	(0.69, 2.95)	0.68	(0.32, 1.44)	0.89	(0.53, 1.47)	0.78	(.47, 1.29)	2.71	(1.57, 4.68)
30-34	2.40	(1.47, 3.94)	2.45	(0.70, 8.61)	0.61	(0.27, 1.36)	0.96	(0.57, 1.63)	0.71	(.42, 1.21)	2.00	(0.99, 4.05)
35-39	1.19	(0.71, 1.98)	5.13	(1.18, 22.33)	0.69	(0.30, 1.57)	0.85	(0.46, 1.60)	0.75	(.40, 1.41)	2.47	(1.22, 5.01)
40+	0.57	(0.26, 1.24)	10.93	(2.17, 55.08)	0.58	(0.26, 1.30)	0.80	(0.45, 1.44)	0.60	(.33, 1.10)	2.40	(1.21, 4.76)
Woman's education												
None	ref		ref		ref		ref		ref		ref	
Any primary	2.24	(1.50, 3.33)	0.65	(0.18, 2.40)	2.00	(1.39, 2.87)	1.88	(1.37, 2.59)	1.71	(1.26, 2.31)	1.94	(1.19, 3.17)
Any secondary	3.16	(2.04, 4.90)	1.05	(0.26, 4.23)	2.60	(1.55, 4.34)	3.00	2.06, 4.37)	2.57	(1.76, 3.75)	2.59	(1.49, 4.47)
Urban residence	4.23	(2.72, 6.57)	2.00	(0.81, 4.89)	2.71	(1.53, 4.79)	6.97	(4.19, 11.60)	8.82	(5.39, 14.44)	2.57	(1.72, 3.83)
# living children												
0-1	ref		ref		ref		ref		ref		ref	
2-3	1.24	(0.91, 1.68)	2.37	(0.23, 24.96)	0.93	().57, 1.50)	0.87	(0.59, 1.30)	1.03	(.69, 1.54)	0.63	(0.40, 1.00)
4-6	1.59	(1.07, 2.37)	7.17	(0.97, 52.85)	0.97	(0.54, 1.73)	0.86	(0.54, 1.36)	1.14	(.72, 1.80)	0.33	(0.18, 0.60)
7+	4.75	(2.44, 9.24)	12.14	(1.42, 103.71)	1.14	(0.56, 2.36)	1.28	(0.71, 2.32)	1.69	(.92, 3.11)	0.48	(0.24, 0.96)

Regression coefficients are adjusted for multi-stage cluster design effects.
Highlighted odds ratios are statistically significant at p < .10 level or better level (one-tailed test).

Table 1c. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected individual determinants: Tanzania 1991

Variable	Modern method use		Clinical method use		Had trained ANC provider		Had trained delivery attendant		Last delivery was facility-based delivery	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI
n	8718		445		5012		5010		5008	
F	24.90		256.22		9.64		20.62		19.17	
df	(14, 304)		(13, 173)		(14, 304)		(14, 304)		(14, 304)	
p	0.000		0.000		0.000		0.000		0.000	
Woman's age										
15-19	ref		Excluded; non-estimable effects		ref		ref		ref	
20-24	4.97	(2.70, 9.13)			1.21	(0.94, 1.56)	1.21	(0.92, 1.59)	1.20	(0.91, 1.58)
25-29	4.90	(2.38, 10.08)			1.41	(1.05, 1.88)	1.54	(1.14, 2.08)	1.47	(1.07, 2.02)
30-34	11.97	(4.88, 29.35)			1.96	(1.41, 2.75)	2.11	(1.41, 3.14)	2.00	(1.34, 2.99)
35-39	13.90	(7.11, 27.15)			1.57	(1.08, 2.30)	2.82	(1.85, 4.31)	2.22	(1.45, 3.40)
40+	9.02	(4.49, 18.10)			1.84	(1.17, 2.91)	3.10	(1.90, 5.05)	2.13	(1.28, 3.53)
Woman's education										
None	ref		ref		ref		ref		ref	
Any primary	5.00	(3.63, 6.88)	0.86	(0.38, 1.95)	1.29	(1.07, 1.57)	1.75	(1.42, 2.16)	1.89	(1.56, 2.30)
Any secondary	8.60	(3.98, 18.57)	1.52	(0.53, 4.34)	2.85	(1.36, 5.98)	6.64	(2.70, 16.34)	5.62	(2.39, 13.21)
Urban residence	2.14	(1.43, 3.21)	0.34	(0.14, 0.81)	2.75	(1.98, 3.82)	5.42	(4.08, 7.20)	5.02	(3.74, 6.75)
# of children ever born										
0-1	ref		ref		ref		ref		ref	
2-3	1.48	(0.89, 2.48)	0.77	(0.28, 2.15)	0.94	(0.75, 1.19)	0.59	(0.48, 0.74)	0.56	(0.45, 0.71)
4-6	1.68	(1.08, 2.61)	0.29	(0.09, 0.92)	0.65	(0.50, 0.83)	0.40	(0.30, 0.53)	0.47	(0.35, 0.62)
7+	2.02	(1.22, 3.35)	0.64	(0.18, 2.20)	0.64	(0.52, 1.06)	0.31	(0.18, 0.52)	0.41	(0.27, 0.61)
HH has electricity	1.92	(1.13, 3.27)	1.94	(0.72, 5.22)	2.02	(1.18, 3.66)	3.34	(1.94, 5.73)	2.53	(1.51, 4.26)
Household assets										
Low	ref		ref		ref		ref		ref	
Medium	1.24	(0.96, 1.60)	0.86	(0.46, 1.62)	1.28	(1.08, 1.52)	1.50	(1.23, 1.82)	1.42	(1.17, 1.71)
High	1.37	(0.93, 2.02)	1.71	(0.84, 3.48)	1.72	(1.32, 2.24)	1.67	(1.29, 2.16)	1.50	(1.15, 1.95)

Regression coefficients are adjusted for multi-stage cluster design effects.
Highlighted odds ratios are statistically significant at $p < .10$ level or better level (one-tailed test).

Table 1d. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected individual determinants: Tanzania 1996

	Modern method use		Clinical method use		Had trained ANC provider at last birth		Had trained delivery attendant at last birth		Last birth was facility-based delivery		Ever had HIV test	
Variable	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI	OR	95% CI
n	7479		969				4157		4055		7210	
F	33.28		9.62				22.07		19.58		10.93	
df	(14, 312)		(14, 224)				(14, 309)		(14, 309)		(14, 312)	
p	0.000		0.000				0.000		0.000		0.000	
Woman's age												
15-19	ref		ref		ref		ref		ref		ref	
20-24	3.18	(2.19, 4.60)	0.72	(0.20, 2.64)	1.11	(0.81, 1.53)	1.19	(0.87, 1.65)	1.28	(0.93, 1.77)	2.49	(1.68, 3.68)
25-29	2.31	(1.49, 3.59)	1.07	(0.26, 4.43)	1.11	(0.78, 1.56)	1.52	(1.05, 2.19)	1.62	(1.12, 2.36)	2.62	(1.66, 4.14)
30-34	2.17	(1.46, 3.23)	4.41	(1.02, 18.99)	1.06	(0.71, 1.57)	2.35	(1.58, 3.50)	2.28	(1.51, 3.43)	3.13	(1.92, 5.10)
35-39	2.42	(1.54, 3.80)	14.04	(2.87, 68.66)	0.91	(0.60, 1.39)	3.35	(2.16, 5.20)	3.67	(2.32, 5.81)	2.73	(1.51, 4.94)
40+	2.11	(1.33, 3.31)	35.00	(6.90, 177.54)	0.96	(0.60, 1.54)	3.66	(2.20, 6.09)	3.84	(2.25, 6.56)	2.50	(1.37, 4.56)
Woman's education												
None	ref		ref		ref		ref		ref		ref	
Any primary	3.68	(2.86, 4.74)	1.48	(0.75, 2.94)	1.35	(1.14, 1.60)	2.54	(1.98, 3.28)	2.32	(1.82, 2.96)	2.64	(1.72, 4.06)
Any secondary	5.57	(3.80, 8.17)	2.71	(0.93, 7.86)	2.00	(1.20, 3.32)	9.64	(4.41, 21.04)	10.08	(4.44, 22.88)	4.23	(2.34, 7.65)
Urban residence	2.77	(2.06, 3.71)	0.74	(0.38, 1.44)	3.56	(2.48, 5.11)	5.81	(4.26, 7.94)	4.46	(3.19, 6.25)	1.43	(0.96, 2.13)
# children ever born												
0-1	ref		ref		ref		ref		ref		ref	
2-3	2.72	(2.08, 3.55)	0.72	(0.28, 1.83)	1.02	(0.80, 1.28)	0.51	(0.39, 0.66)	0.45	(0.36, 0.47)	0.94	(0.67, 1.32)
4-6	3.94	(2.94, 5.30)	0.53	(0.15, 1.79)	1.12	(0.84, 1.49)	0.33	(0.24, 0.46)	0.33	(0.24, 0.44)	0.87	(0.57, 1.32)
7+	5.51	(3.75, 8.09)	0.70	(0.18, 2.81)	1.03	(0.69, 1.53)	0.23	(0.15, 0.36)	0.20	(0.13, 0.31)	0.59	(0.33, 1.05)
HH has electricity	1.66	(1.21, 2.26)	1.86	(1.01, 3.43)	1.32	(0.84, 2.06)	3.01	(1.92, 4.73)	3.36	(2.02, 5.59)	2.02	(1.33, 3.07)
Household assets												
Low	ref		ref		ref		ref		ref		ref	
Medium	1.22	(0.99, 1.50)	1.93	(1.08, 3.45)	1.10	(0.94, 1.28)	1.07	(0.89, 1.29)	1.18	(0.97, 1.44)	1.13	(0.85, 1.52)
High	1.43	(1.12, 1.83)	2.63	(1.46, 4.77)	1.20	(0.97, 1.49)	1.39	(1.12, 1.73)	1.51	(1.20, 1.91)	0.80	(0.57, 1.12)

Regression coefficients are adjusted for multi-stage cluster design effects.
Highlighted odds ratios are statistically significant at $p < .10$ level or better level (one-tailed test).

Table 1e. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected individual determinants: Uttar Pradesh, India 1995

	Modern method use		Clinical method use		Had trained ANC provider provider for last birth		Had trained delivery attendant at last birth		Last delivery was facility-facility-based	
Variable	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI
n	44305		10897		3171		3129		3165	
F	299.18		110.40		24.40		26.90		27.92	
df	(14, 2248)		(14, 2108)		(14, 395)		(14, 395)		(14, 395)	
p	0.000		0.000		0.000		0.000		0.000	
Woman's age										
15-19	ref		ref		ref		ref		ref	
20-24	1.89	(1.54, 2.33)	2.59	(1.59, 4.24)	0.97	(0.69, 1.36)	0.92	(0.59, 1.43)	1.07	(0.63, 1.83)
25-29	3.88	(3.13, 4.80)	5.83	(3.57, 9.54)	0.93	(0.62, 1.38)	1.27	(0.78, 2.07)	1.62	(0.90, 2.92)
30-34	6.50	(5.24, 8.06)	10.33	(6.23, 17.13)	1.07	(0.70, 1.65)	1.47	(0.86, 2.51)	1.83	(0.98, 3.42)
35-39	9.64	(7.75, 12.00)	19.28	(11.70, 31.77)	0.95	(0.57, 1.59)	1.78	(0.91, 3.49)	3.00	(1.45, 6.18)
40+	10.61	(8.50, 13.23)	47.69	(28.54, 79.71)	1.15	(0.61, 2.14)	1.50	(0.64, 3.48)	2.37	(0.86, 6.55)
Woman's education										
None	ref		ref		ref		ref		ref	
Any primary	1.60	(1.46, 1.76)	0.91	(0.76, 1.10)	1.91	(1.44, 2.54)	1.55	(1.03, 2.33)	1.36	(0.84, 2.20)
Any secondary	2.22	(2.04, 2.42)	0.66	(0.57, 0.76)	3.67	(2.76, 4.88)	3.87	(3.00, 4.99)	4.07	(3.09, 5.35)
Urban residence	1.22	(1.10, 1.34)	0.51	(0.43, 0.60)	2.30	(1.73, 3.05)	2.27	(1.65, 3.11)	2.95	(2.14, 4.08)
# of children ever born										
0-1	ref		ref		ref		ref		ref	
2-3	3.93	(3.50, 4.41)	3.72	(2.91, 4.76)	0.99	(0.74, 1.31)	0.65	(0.49, 0.86)	0.41	(0.36, 0.72)
4-6	4.09	(3.62, 4.62)	4.55	(3.52, 5.87)	0.86	(0.61, 1.20)	0.44	(0.30, 0.66)	0.39	(0.25, 0.60)
7+	1.96	(1.70, 2.27)	1.90	(1.39, 2.60)	0.74	(0.47, 1.16)	0.38	(0.21, 0.69)	0.31	(0.15, 0.65)
HH has electricity	1.54	(1.41, 1.69)	0.86	(0.71, 1.05)	1.67	(1.27, 2.19)	1.37	(0.93, 2.03)	1.31	(0.80, 2.16)
Household assets										
Low	ref		ref		ref		ref		ref	
Medium	1.27	(1.17, 1.38)	0.88	(0.68, 0.98)	1.19	(0.93, 1.54)	0.91	(0.67, 1.23)	1.32	(0.87, 1.99)
High	1.49	(1.33, 1.66)	0.76	(0.62, 0.95)	1.85	(1.30, 2.64)	2.23	(1.57, 3.16)	2.70	(1.65, 4.44)

Regression coefficients are adjusted for multi-stage cluster design effects.
Highlighted odds ratios are statistically significant at p < .10 level or better level (one-tailed test).

Table 2a. Results of multilevel logistic regressions of woman's likelihood of FP/RH services behaviors on selected health facility and individual determinants: Paraguay 1998

Variable	Modern method use OR	95%CI	Clinical method use OR	95%CI	Had trained ANC provider for last birth OR	95%CI	Had trained delivery attendant at last birth OR	95%CI	Last delivery was facility-based OR	95%CI
n	2049		785		Outcome nearly		722		722	
F	12.68		3.58		universal;		6.95		6.59	
df	(23, 84)		(23, 83)		determinants not		(23, 46)		(23, 46)	
p	0.000		0.000				0.000		0.000	
Facility type	Not included; all women had access to each type of facility within 30 km									
# of doctors	1.00	(1.00, 1.02)	1.00	(0.99, 1.02)			1.01	(0.98. 1.05)	1.00	(0.97, 1.02)
# of paramedicstaff	0.99	(0.98, 1.00)	1.01	(0.99, 1.03)			1.01	(0.98, 1.04)	1.02	(0.99, 1.05)
# FP-trained doctors	1.22	(1.08, 1.37)	1.05	(0.84, 1.31)			na	na	na	na
# FP-trained paramedics	1.03	(0.92, 1.15)	1.07	(0.85, 1.35)			na	na	na	na
# FP methods	1.21	(0.96, 1.51)	1.53	(1.01, 2.33)			na	na	na	na
# MCH services at hospital<=30km	na	na	na	na			0.89	(0.76, 1.05)	0.93	(0.80, 1.08)
# MCH services at health center<=30km	na	na	na	na			0.71	(0.56, 0.89)	0.77	(0.62, 0.96)
# MCH services at health post<=30km	na	na	na	na			1.03	(0.84, 1.26)	0.91	(0.76, 1.08)
# methods/drugs out of stock last 6 months	0.96	(0.89, 1.04)	1.01	(0.90, 1.14)			1.13	(0.93, 1.36)	1.20	(0.99, 1.46)
Any outreach (FP talk/MCH poster)	0.69	(0.38, 1.22)	1.05	(0.48, 2.31)			3.55	(1.52, 8.30)	1.37	(0.63, 2.99)
Distance to nearest hospital	1.01	(1.00, 1.02)	1.01	(0.97, 1.03)			1.01	(0.98, 1.03)	1.01	(0.99, 1.03)
Distance to nearest health center	1.01	(0.99, 1.04)	0.99	(0.95, 1.03)			0.96	(0.92, 1.01)	0.97	(0.93, 1.01)
Distance to nearest health post	0.96	(0.94, 0.99)	0.97	(0.93, 1.01)			0.93	(0.89, 0.98)	0.92	(0.88, 0.95)

Regression coefficients are adjusted for multi-stage cluster design effects. Odds ratios and 95%CIs for individual levels factors (as in Table 6) not shown but are included in the models. Highlighted odds ratios are statistically significant at p< .10 level or better level (one-tailed test)

Table 2b. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected health facility and individual determinants: Uganda 1997

	Modern method use		Clinical method use		Had trained ANC provider		Had trained delivery attendant		Had facility-based delivery		Ever had HIV test	
Variable	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI	OR	95% CI
n	1680		311		1224		1224		1224		1672	
F	7.35		2.90		8.32		8.64		6.49		4.92	
df	(22, 50)		(22, 42)		(21, 51)		(21, 51)		(21, 51)		(21, 51)	
p	0.000		0.002		0.000		0.000		0.000		0.000	
Message exposure												
None	ref		ref		ref		ref		ref		ref	
Electronic	2.00	(1.26, 3.18)	0.56	(0.14, 2.24)	1.84	(1.24, 2.72)	1.66	(1.18, 2.35)	1.48	(1.04, 2.11)	1.52	(0.95, 2.41)
Print only	1.44	(0.85, 2.45)	1.45	(0.29, 7.17)	1.36	(0.90, 2.05)	1.31	(0.85, 2.01)	1.21	(0.79, 1.84)	1.80	(1.08, 3.00)
Facility type												
Health post	ref		ref		ref		ref		ref		ref	
Health center	0.93	(0.55, 1.59)	1.11	(0.40, 3.08)	1.37	(0.78, 2.42)	1.78	(0.85, 3.73)	1.59	(0.79, 3.23)	1.30	(0.83, 2.07)
Hospital	0.79	(0.50, 1.25)	2.53	(0.82, 7.79)	1.66	(0.68, 4.06)	1.70	(0.58, 4.98)	1.44	(0.49, 4.19)	1.41	(0.91, 2.18)
Government authority	1.65	(0.93, 2.90)	2.17	(0.56, 8.39)	1.18	(0.67, 2.08)	1.58	(0.79, 3.15)	1.65	(0.87, 3.14)	1.09	(0.76, 1.57)
# of methods/ services	1.10	(0.97, 1.25)	0.78	(0.57, 1.07)	0.80	(0.59, 1.10)	0.80	(0.58, 1.11)	0.84	(0.61, 1.16)	1.23	(0.92, 1.65)
# trained FP providers	0.80	(0.67, 0.96)	1.07	(0.70, 1.64)	na		na		na		na	
# trained staff	1.01	(0.98, 1.04)	0.98	(0.94, 1.03)	1.00	(0.97, 1.03)	0.99	(0.96, 1.01)	0.99	(0.96, 1.03)	0.99	(0.97, 1.00)
# methods/ drugs out of stock last month	0.69	(0.51, 0.94)	2.04	(0.84, 4.95)	1.07	(0.79, 1.44)	1.09	(0.81, 1.46)	1.02	(0.76, 1.38)	0.96	(0.61, 1.51)
Any outreach	1.23	(0.83, 1.83)	0.76	(0.28, 2.04)	0.75	(0.40, 1.39)	0.91	(0.50, 1.64)	0.88	(0.50, 1.54)	0.59	(0.41, 0.85)
Distance to nearest health facility	0.96	(0.91, 1.01)	1.00	(0.81, 1.22)	0.95	(0.92, 0.98)	0.92	(0.86, 0.98)	0.92	(0.85, 0.99)	0.95	(0.89, 1.01)

Regression coefficients are adjusted for multi-stage cluster design effects. Odds ratios and 95%CIs for individual level factors (as in Table 6) not shown but are included in the models. Highlighted odds ratios are statistically significant at $p < .10$ level or better level (one-tailed test).

Table 2c. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected health facility and individual determinants: Tanzania, 1991

	Modern method use		Clinical method use		Had trained ANC provider		Had trained delivery attendant		Had facility-based delivery	
Variable	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI
n	8718		445		5012		5010		5008	
F	13.47		754.89		8.74		16.15		13.19	
df	(27, 291)		(27, 159)		(24, 294)		(24, 294)		(24, 294)	
p	0.000		0.000		0.000		0.000		0.000	
Government authority	0.79	(0.65, 0.95)	0.63	(0.37, 1.08)	0.76	(0.65, 0.90)	0.63	(0.55, 0.73)	0.65	(0.54, 0.80)
# of doctors	1.04	(0.99, 1.10)	0.93	(0.84, 1.02)	0.98	(0.93, 1.03)	0.98	(0.93, 1.03)	0.98	(0.92, 1.03)
# of paramedic staff	1.00	(0.99, 1.00)	1.00	(0.99, 1.01)	1.00	(1.00, 1.01)	1.00	(1.00, 1.01)	1.00	(1.00, 1.01)
# FP-trained doctors	0.84	(0.58, 1.21)	1.83	(0.74, 4.53)	na		na		na	
# FP-trained paramedic	0.93	(0.82, 1.06)	1.23	(0.86, 1.76)	na		na		na	
# methods/services	1.08	(0.98, 1.19)	1.00	(0.74, 1.35)	1.36	(1.21, 1.54)	1.28	(1.13, 1.45)	1.28	(1.13, 1.44)
# methods/drugs out of stock last 6 mos	0.90	(0.81, 1.00)	0.97	(0.73, 1.28)	1.08	(1.01, 1.16)	1.03	(0.96, 1.11)	1.01	(0.93, 1.10)
Condoms out of stock last 6 months	1.11	(0.81, 1.53)	0.67	(0.31, 1.48)	na		na		na	
Any outreach	1.74	(1.11, 2.72)	2.88	(0.66, 12.63)	0.86	(0.53, 1.41)	1.67	(0.93, 3.00)	2.13	(1.15, 3.96)
# of hospitals <= 30 km	1.35	(1.17, 1.56)	1.48	(1.09, 2.02)	1.29	(1.10, 1.51)	1.46	(1.23, 1.74)	1.20	(1.00, 1.45)
# of health centers <= 30 km	0.88	(0.77, 1.00)	0.95	(0.72, 1.25)	0.96	(0.83, 1.10)	1.07	(0.91, 1.24)	1.17	(0.99, 1.38)
# of dispensaries <= 30 km	0.94	(0.84, 1.05)	1.14	(0.82, 1.58)	0.99	(0.87, 1.12)	0.98	(0.87, 1.10)	1.05	(0.91, 1.20)
Distance to nearest health facility	0.98	(0.94, 1.02)	1.13	(1.02, 1.26)	0.98	(0.94, 1.00)	0.93	(0.90, 0.96)	0.89	(0.85, 0.92)

Regression coefficients are adjusted for multi-stage cluster design effects. Odds ratios and 95%CIs for individual level factors (as in Table 6) not shown but are included in the models. Highlighted odds ratios are statistically significant at $p < .10$ level or better level (one-tailed test).

Table 2d. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected health facility and individual determinants: Tanzania 1996

	Modern method use		Clinical method use		Had trained ANC provider		Had trained delivery attendant		Had facility-based delivery		Ever had HIV test	
Variable	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI	OR	95% CI
n	7479		969		4150		4157		4055		7210	
F	19.24		7.50		9.48		14.17		13.46		8.65	
df	(29, 297)		(29, 209)		(25, 298)		(25, 298)		(25, 298)		(27, 299)	
p	0.000		0.000		0.000		0.000		0.000		0.000	
Message exposure												
None	ref		ref		na		na		na		ref	
Electronic	2.57	(2.03, 3.25)	1.56	(0.83, 2.95)							2.10	(1.40, 3.15)
Print only	1.92	(1.28, 2.86)	1.29	(0.38, 4.37)							0.45	(0.10, 1.92)
Any hospital < 30km	0.78	(0.41, 1.46)	0.19	(0.03, 1.28)	0.61	(0.42, 0.89)	0.81	(0.53, 1.22)	1.06	(0.62, 1.82)	1.27	(0.45, 3.60)
Any health ctr < 30 km	0.72	(0.50, 1.04)	1.63	(0.67, 3.99)	0.86	(0.49, 1.54)	1.08	(0.64, 1.80)	1.29	(0.75, 2.24)	1.01	(0.53, 1.95)
Any dispensary < 30 km	0.98	(0.60, 1.59)	0.24	(0.07, 0.83)	2.47	(1.20, 5.11)	0.05	(0.47, 3.10)	1.18	(0.40, 3.48)	1.99	(0.80, 4.92)
NGO clnc < 30km	1.22	(0.88, 1.69)	0.62	(0.29, 1.33)	2.27	(1.58, 3.26)	1.80	(1.17, 2.77)	1.17	(0.75, 1.83)	1.08	(0.69, 1.70)
Govt authority	0.85	(0.71, 1.02)	0.85	(0.60, 1.19)	0.98	(0.78, 1.23)	0.72	(0.57, 0.90)	0.71	(0.54, 0.93)	0.74	(0.59, 0.94)
# doctors	1.00	(0.99, 1.01)	1.01	(1.00, 1.03)	0.99	(0.98, 1.00)	1.00	(0.99, 1.01)	0.10	(0.99, 1.03)	1.00	(0.99, 1.01)
# paramedic	1.00	(1.00, 1.00)	1.00	(0.99, 1.00)	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
# FP-trained MD	0.98	(0.71, 1.35)	1.82	(0.79, 4.22)	na		na					
# FP-trained para	1.15	(1.01, 1.31)	1.13	(0.84, 1.51)	na		na					
# methods/ services	0.98	(0.87, 1.10)	1.79	(1.26, 2.54)	1.14	(0.95, 1.37)	1.64	(1.18, 2.26)	1.56	(1.03, 2.34)	1.37	(0.98, 1.93)
# methods out of stock last year	1.03	(0.95, 1.12)	0.71	(0.57, 0.89)	1.02	(0.93, 1.12)	0.93	(0.84, 1.04)	0.97	(0.85, 1.10)	1.02	(0.85, 1.23)
Any outreach	1.21	(0.86, 1.70)	0.47	(0.23, 0.94)	0.57	(0.31, 1.04)	0.90	(0.51, 1.58)	0.90	(0.58, 1.41)	0.82	(0.46, 1.46)
Distance to nearest health facility	0.95	(0.91, 0.99)	0.93	(0.85, 1.01)	1.01	(0.98, 1.03)	0.94	(0.90, 0.99)	0.92	(0.87, 0.96)	0.97	(0.92, 1.02)

Regression coefficients are adjusted for multi-stage cluster design effects. Odds ratios and 95%CIs for individual level factors (as in Table 6) not shown but are included in the models. Highlighted odds ratios are statistically significant at p < .10 level or better level (one-tailed test).

Table 2e. Results of multilevel logistic regressions of woman's likelihood of FP/RH service utilization behaviors on selected health facility and individual determinants: Uttar Pradesh, 1995

	Modern method use		Clinical method use		Had trained ANC provider		Had trained delivery attendant		Had facility-based delivery	
Variable	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95%CI
n	44265		10884		3717		3129		3165	
F	150.62		50.98		17.64		18.14		19.48	
df	(30, 2232)		(30, 2092)		(23, 386)		(23, 386)		(23, 386)	
p	0.000		0.000		0.000		0.000		0.000	
Message exposure										
None	ref		ref		na		na		na	
Electronic	2.070	(1.92, 2.24)	0.550	(0.60, 0.80)						
Print only	1.520	(1.35,1.71)	0.540	(0.46, 0.83)						
# of primary level facilities	0.99	(0.97, 1.03)	1.03	(0.99, 1.08)	0.84	(0.74, 0.97)	1.19	(0.98,1.43)	1.07	(0.88, 1.31)
# of 2ndry level facilities	1.01	(0.92, 1.07)	0.97	(0.85, 1.10)	0.93	(0.72, 1.22)	1.240	(0.87, 1.78)	0.960	(0.63, 1.46)
# of tertiary level facilities	1.04	(1.00, 1.07)	1.01	(0.97, 1.06)	1.11	(0.99, 1.25)	1.010	(0.91, 1.12)	1.030	(0.94, 1.13)
Government authority	0.94	(0.90, 0.99)	0.95	(0.88, 1.03)	0.86	(0.69, 1.08)	0.77	(0.57, 1.05)	0.88	(0.61, 1.26)
# doctors	0.98	(0.97, 1.01)	1.00	(0.97, 1.03)	1.05	(0.97, 1.13)	1.15	(1.05, 1.26)	1.13	(1.03, 1.24)
# trained paramedics	1.00	(1.00, 1.01)	0.99	(0.98, 1.00)	1.06	(1.04, 1.08)	0.98	(0.96, 1.01)	1.00	(0.98, 1.02)
# FP-trained doctors	1.11	(1.07, 1.17)	1.08	(1.00, 1.16)	na		na		na	
# FP-trained paramedics	0.96	(0.94, 0.98)	1.03	(1.00, 1.05)	na		na		na	
# methods/services	0.96	(0.92, 1.01)	0.89	(0.82, 0.97)	1.02	(0.88, 1.17)	0.90	(0.75, 1.08)	0.94	(0.80, 1.11)
IUD stockout < last year	0.93	(0.84, 1.03)	0.93	(0.77, 1.13)	na		na		na	
Pill stockout < last year	1.17	(1.02, 1.32)	0.95	(0.75, 1.21)	na		na		na	
Condom stockout <last yr	0.97	(0.82, 1.09)	0.94	(0.72, 1.22)	na		na		na	
Other method/ stockout <1 yr	1.14	(0.93, 1.42)	1.13	(0.81, 1.56)	1.06	(0.93, 1.20)	0.92	(0.79, 1.08)	0.95	(0.81, 1.11)
Any outreach	1.10	(0.96, 1.17)	0.99	(0.34, 1.18)	1.16	(0.78, 1.72)	1.63	(1.07, 2.48)	1.13	(0.70, 1.81)

Regression coefficients are adjusted for multi-stage cluster design effects. Odds ratios and 95%CIs for individual level factors (as in Table 6) not shown but are included in the models. Highlighted odds ratios are statistically significant at $p < .10$ level or better level (one-tailed test).