AN EQUITY ANALYSIS OF PERFORMANCE-BASED FINANCING IN RWANDA

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Abstract

MARTHA PRIEDEMAN SKILES: An equity analysis of performance-based financing in Rwanda
(Under the direction of Dr. Siân L. Curtis)

Maternal and child health services favor the wealthiest in lower and middle income countries. Debate about the potential of performance-based financing (PBF) to address these disparities continues. As PBF is adopted by other countries, it is critical to understand the equity effects for primary health care services. The aim of this dissertation is to evaluate the effects of PBF on equity in maternal and child health service use when no specific provisions target the poorest in the population.

In Rwanda, PBF was designed to increase health service use and improve quality of services provided. Paired districts were randomly assigned to intervention and control for PBF implementation. Using Rwanda's Demographic Health Survey data from 2005 (pre-intervention) and 2007-08 (post-intervention), cluster-level panel datasets of 7,899 women 15-49 years of age and 5,781 children 0-59 months living in intervention and control districts were created. A difference-in-differences estimation strategy was used to evaluate the program impact of PBF on select primary maternal and child health service outcomes. Interaction terms between wealth quintiles and PBF were estimated to identify the differential effect of PBF among women and children from poorer households.

Health service use for women and children increased for intervention and control populations and across all wealth quintiles from 2005 to 2007. The probability of a facility delivery, the most incentivized service, was significantly higher in PBF districts, while no effect of PBF was found for ANC visits, contraceptive use, or care-seeking for childhood illness. No evidence that PBF was a pro-poor or a pro-rich strategy for increasing access was found.

Treatment received for childhood illnesses, however, significantly improved for children in PBF districts, and data suggests that poorer children benefited more.

These results indicate that PBF may be an effective strategy for increasing access when use is uniformly low and a service is well incentivized; but PBF will do little to alleviate disparities in service use. The larger effect of PBF on quality of services, which remains within the control of the facility and provider, suggests that PBF does positively impact health care quality and may narrow the equity gap.

To Jeff, Amelia, Lucy, and Frances.

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Chapter 1

Introduction

In Rwanda, considerable improvements have been reported for select maternal and child health indicators, including higher contraceptive prevalence, earlier use of antenatal care (ANC), more facility versus home births, increased childhood immunization coverage, and increased care-seeking for ill children.[1-3] These indicators collectively point to improved use of health services, yet give little illumination about why service use has increased. Moreover, an inequity in service use between the richest and the poorest has been noted.[3]

In 2005, Rwanda formally adopted a national performance-based financing (PBF) initiative to increase health care worker productivity and quality of services provided at hospitals and health centers.[4] This dissertation seeks to determine whether a PBF program, without equity targets, can differentially impact the use of select, preventive and curative health care services among the poorest women and children in Rwanda.

Maternal and Child Health

Maternal and child survival continue to improve globally, yet many countries will not meet the Millennium Development Goals (MDGs) by 2015. In September 2000, the international community committed to reducing maternal mortality by three quarters (MDG 5) from 1990 to 2015.[5] As 2015 rapidly approaches, assessments of progress towards this goal have found that the majority of countries in sub-Saharan Africa are not on track.[6-9] The United Nations (UN) reported only a 26% decrease in the maternal mortality ratio (MMR) from 870 deaths per 100,000 live births in 1990 to 640 deaths per 100,000 live births in 2008 for sub-Saharan Africa.[10]

Childhood mortality has also declined globally in the past 20 years to 60 deaths per 1,000 live births in 2009, yet the possibility of meeting the targeted two-thirds reduction for MDG 4 remains elusive.[10] In sub-Saharan Africa where pneumonia, diarrhea, and malaria remain the leading killers for children under five, the mortality rate remains twice that of the global average.[10] Particularly vulnerable are children from the poorest households who are 80% more likely to die in the first five years of life compared to children from the wealthiest households.[10]

In Rwanda, progress in meeting the MDGs historically has not been consistent or adequate, yet remarkable progress has been made in the past decade. The maternal mortality rate was declining prior to the 1994 genocide, reversed itself during the war years, before starting to decline again after 2000.[10] Maternal mortality rose from 1,100 deaths per 100,000 live births in 1990 to 1,400 in 1995 then dropped to a new low of 540 in 2008, marking a 50.9% decrease from 1990 to 2008.[10]

Service indicators for maternal health in Rwanda have shown remarkable improvements in the past decade. The latest Demographic and Health Survey (DHS) reports an improvement in facility deliveries from 28% in 2005 to 69% in 2010.[3] Similarly modern contraceptive use among married women increased dramatically from 10% in 2005 to 45% in 2010.[3] The equity gap in maternal service use has also improved since 2005, when a 50 percentage point difference in facility deliveries existed between the poorest and least poor wealth quintile. This gap closed to 29 percentage points in 2007.[2] A parallel trend was seen for modern contraceptive use with only a 7 percentage point gap in 2007, down from 21 percentage points in 2005.[2] Efforts that contributed to this closing of the equity gap have been suggested but not rigorously examined.

Rwanda has made considerable progress in their efforts to improve child survival post-wartime when mortality fell precipitously from 186 under-five mortality rate in 2000 to 112 under-five mortality rate in 2008.[7] As of 2006, Bryce et al. estimated that Rwanda would need to maintain an annual 11% reduction in child mortality from 2007 to 2015 in order to achieve MDG 4.[9] According to the 2010 Rwanda Demographic Health Survey (RDHS), the under-five mortality rate has declined by 50% since the 2005 RDHS, which may put Rwanda within striking distance of the 2015 target. Unfortunately this improved child survival is not uniform across Rwanda. In an equity analysis of childhood illness and mortality, the poorest quintile of households had a 58% higher infant mortality rate, a 60% higher under-five mortality rate, and over 40% higher prevalence of fever, diarrhea and acute respiratory infections compared to the least poor 20% of households.[11] Moreover, the rate of severe stunting and severe underweight status among children was twice as high among the poorest compared to the least poor.[11] Review of data from repeated DHS in Rwanda confirm this pattern of disparate health outcomes, with wealth quintiles inversely associated with morbidity.[12-14] The exception to this trend was reported by Hong et al. who found that wealth was not predictive of childhood mortality in a pooled dataset from four DHS spanning 1992-2007; however, wealth status was grouped in terciles rather than quintiles without stratification by rural residence, which may have masked some of the differences, and the period reviewed included the war years which may also have affected findings.[15]

Jones and colleagues in 2003, evaluated the potential impact of multiple preventive and curative child survival interventions.[16] Based on this work, Bryce and colleagues assessed individual country coverage of eight of these interventions deemed to have "the highest potential impact on child mortality" if universal coverage is achieved.[17] For Rwanda, measles and DPT immunization, vitamin A supplementation and use of insecticide-treated bednets were found to be on track in 2007-08; use of a skilled birth attendant and oral rehydration therapy (ORT) were increasingly common but continued to require monitoring; while care-seeking for pneumonia and antimalarial treatment received had achieved less than 30% coverage, well below that needed to reduce mortality rates.[14, 17]

Preventive efforts such as immunizations, vitamin A supplements, and distribution of treated bednets, benefit from national campaigns that universally target vulnerable populations. Many curative interventions rely on formal health services offered through health facilities responding to acute needs. The success of facility-based interventions, such as Safe Motherhood Programs or Integrated Management of Childhood Illnesses (IMCI), requires a base level of service use to have a measurable effect.[18]

Equity in Health and Health Service Use

The overarching intent of the complete set of MDGs is to improve the life circumstances of the poor; however, the health-specific MDGs obscure this focus by monitoring national changes in health status rather than the differential changes for the poorest.[19-21] Development of the health-specific MDGs – reduction in child mortality, maternal mortality, and infectious disease incidence – was based on the assumption that public health spending on programs that target "diseases of the poor" will primarily benefit the poor.[22] Yet assessments of MDG progress have demonstrated that countries can continue to improve their MDG indicators through advancements primarily among the wealthier population while notably not improving the health status of the poorest among them.[23, 24] In a multi-country analysis of child mortality, Gwatkin and colleagues found that the under-five mortality rate was 70% lower among the wealthiest compared to the poorest in sub-Saharan Africa.[19] Poverty Reduction Strategy Papers required for heavily indebted poor countries to qualify for debt relief from the World Bank and International Monetary Fund are similarly devoid of health strategies that focus exclusively on the poor.[25, 26] The World Development Report 2004 found countries failed to adequately allocate health resources to the poor, rather the wealthiest received the largest proportion of benefits.[26]

The poorest of the population need intentional health services because they remain at higher risk for morbidity and mortality. Women and children from poorer families have higher exposure to communicable and chronic diseases due to inadequate sanitation, insufficient drinking water, poor housing, and poor air quality, coupled with diminished resistance to disease due to malnutrition and micro-nutrient deficiencies.[27] Exacerbating this problem, health facilities located in poorer communities are frequently understaffed, poorly equipped, and less well organized, resulting in health services less responsive to the needs of the population.[27]

Primary maternal and child health services continue to favor the wealthiest in lower and middle income countries. Use of health services and particularly adoption of new health interventions typically follow Rogers Theory of Diffusion of Innovations, with the wealthy adopting services first.[28] The "inverse care law" proposed by Tudor-Hart [29] and added to by Victora and colleagues,[30] take it a step further advocating that health services benefit those who least need them which exacerbates health inequities between the richest and poorest. Not until the richest have maximized the potential benefit of the intervention, will the benefits trickle down to the poorest among them.[30] The poorer among the population often face more limited choices for services, require more education about the value of services, and face other economic priorities that compete for their limited time and resources. Even programs developed specifically to reach the poorest populations, such as oral rehydration therapy, were still more likely to reach those with greater economic resources, albeit in a less pro-rich manner than general health services.[31, 32] The Countdown 2015 report found that uniform, simple preventive services with vertical implementation, such as immunizations and treated bednets, were more equitably consumed compared to curative services such as treatment of malaria and diarrhea, and services that required access to 24-hour clinical care such as deliveries.[9] Castro-Leal and colleagues reported similar findings from a multi-country analysis in Africa, where curative care services favor the wealthy compared to preventive care services.[33]

Wealth has been significantly associated with maternal and child health service utilization in numerous African and Southeast Asian countries.[34-40] Boerma and colleagues in an analysis of 54 countries calculated the gap between maximum use of services and actual use of services. They found that the largest gap in services provision was for family planning, maternal and newborn care, and treatment of ill children.[41] The largest equity gap in service provision, that is the largest difference in service use between the wealthiest and the poorest, was for skilled delivery, 33.9% difference in use, and antenatal care, 21.1% difference.[41] In Rwanda, the use of health services and the adoption of maternal and child health interventions such as modern contraceptives, skilled deliveries, child and adult immunizations, as well as seeking skilled care for childhood illnesses, dropped or remained dangerously low in the years preceding and following the war.[42, 43] By 2000, according to Boerma's analysis, the combined gap in service provision for maternal and child health services was 51.7% and declined slightly to 46.9% in 2005; still almost half of the population was not receiving primary maternal and child health services.[41] By 2005, the wealthiest, on average, used health services at a rate 16.3% higher than the poorest. This analysis of DHS data provides evidence of "top inequity" in Rwanda, essentially evidence of some parallel trends in service use by wealth quintile, except among the very wealthiest who show a sharp increase in service use.[41]

The inequity in service utilization between the poorest and the less poor highlights the need to develop interventions to reach the poor. Health interventions need to motivate the poor households to seek services or encourage the providers to reach out to those populations.[44] Approaches range from targeting the individual to addressing the health infrastructure, and multiple approaches are needed. Moreover, every intervention developed, whether with or without a specific equity focus, should be evaluated for its impact on equity.[27] Without continued attention on the equitable distribution and uptake of health services, the poorest will remain at a disadvantage.

Rwanda's Health Reforms

Rwanda has undertaken a set of national health reforms over the past several years with evidence of improving health status nationally; however, it remains unclear whether these reforms have differentially affected the poor. The health system infrastructure, both facilities and human resources, was severely harmed during the 1994 genocide in Rwanda. Afterwards, extensive donor aid flooded the country to rebuild facilities and reestablish training programs. By

2005, approximately 60% of the total population lived within 5 kilometers of a health facility and 85% lived within 10 kilometers;[4] as of 2007, total government spending on health was approximately $12-14 per person; yet health staffing fell below international standards with many districts supporting only two doctors per 100,000 population.[45] A series of health sector reforms were adopted in the mid-2000s to improve provision and access to primary care services, including decentralization, coordination of donor aid, performance-based financing, and community-based health insurance.

The Government of Rwanda (GoR) adopted of a policy of decentralization in 2005, which was the prelude to substantial changes to the structure and autonomy of the public health sector in Rwanda. The aim of decentralization was to empower local administrative bodies to take on a leadership role in the administration and decision-making for local services, including health, education, and economic activities. In 2006, 30 new administrative districts replaced the former 106 health districts. These new districts were tasked with operations for all development areas and were encouraged to work with communities in a more proactive decision-making role.[46] Each new administrative district included at least one district hospital and multiple health centers and health posts that fed referrals to the district hospital.

Meanwhile, the GoR established a financial framework to actively manage and coordinate the donor funds supporting the health system.[47] The GoR determined that it was in the best interest of Rwanda to have a strong, central voice in directing funds towards government-supported health priorities while minimizing duplication when possible.[47]

In the context of these reforms, two financing strategies were implemented to maximize health facility productivity and use. In 2005, following 3 pilot projects, the GoR adopted a national performance-based financing (PBF) program for health centers and hospitals. This financing program was designed to incentivize providers and facility personnel to increase health service productivity and improve service quality through special contracting at the facility-level. To facilitate increased use by the consumer, a national health insurance law was adopted in 2006, requiring households to purchase health insurance, largely through a community-based health insurance (CBHI) program, or Mutuelle de Santé. Mutuelles were developed in an effort to mobilize resources locally for health centers and to reduce the financial barriers and risks families faced with unexpected medical costs. Mutuelle benefits are decided by a local health committee and cover a standard set of primary health care services, such as family planning, antenatal care, deliveries, consultations, lab work and generic drugs. Participation requires an enrollment fee and annual premium, with the poorest in the village, as decided by the village committee, eligible for donor subsidies to cover the premiums. By 2006, 73% of the population reported participation in a Mutuelle.[47]

The adoption of PBF in Rwanda has been closely watched to determine whether this type of funding strategy can positively impact service use in a lower income country. The evidence for increased use of preventive services is mounting; however, the effects on use of curative care and overall equity in access have not been scrutinized.

Performance-Based Financing

Performance-based financing, results-based financing, pay-for-performance, and output-based financing are a sample of the multiple names for health financing strategies that specify the transfer of money or goods in exchange for a measurable action or performance target.[48] These financing strategies focus on demand-side incentives for service consumers or supply-side incentives for service providers.[44, 48, 49] Demand-side incentives can include conditional cash transfers or vouchers, which incentivize individuals to seek specific preventive or curative care. Supply-side incentives, such as salary supplements, assume that appropriate monetary incentives will increase output, improve quality, and ultimately improve health outcomes.[50] PBF is a type of results-based financing that uses only supply-side financial incentives for select quality services.[49] This results financing was described by Meessen and colleagues as “a mechanism by which health providers are, at least partially, funded on the basis of their performance...contrasted with the line-item approach, which finances a health facility through the provision of inputs (e.g., drugs, personnel)."[51(p.153)]

PBF models are attracting attention as donors and governments look towards innovative ways to meet the 2015 MDGs. While PBF models vary by objective, health system and country setting, they can loosely be grouped by type of contracting mechanism: a) between international donor and national government; b) between government or donor and private contractor; or c) between national and local governments.[52, 53] Donors such as the Global Alliance for Vaccines and Immunization (GAVI) and the Global Fund to Fight AIDS, Tuberculosis, and Malaria, expect measurable results for the aid provided, tying subsequent funds to demonstrated improvements such as immunization coverage rates or bednet distribution.[53] Examples of contracting within middle and low income countries include private or NGO contracting in Haiti, Guatemala, Afghanistan, India, Bangladesh and Cambodia; as well as contracting within the public sector or between the levels of government, notably in Rwanda, Brazil, Egypt and more recently in Burundi and Tanzania.[50, 52-57] The common thread among these models is the contracting mechanism that ties funding to performance in an effort to solve the principal-agent problem.[52] Essentially the principal-agent problem arises when the principal or contracting party wants the agent or contractor to perform in a certain manner but the separation of the two may lead the contractor to act in their own best interest. The contracting mechanism then needs to include appropriate monitoring and incentives to achieve the desired result. PBF contracts are designed to motivate the agent, in this case the health facility or provider, to meet a set of measurable performance indicators that the principal or funder can easily and accurately monitor.[48, 52, 58] Despite the different models and settings, the goal of PBF across countries is more similar than different: to increase the availability and use of quality maternal and child health services. As noted by Canavan and colleagues, the MCH indicators used to track and reward performance across PBF contracts consistently include contraceptive adoption and continuation, ANC use, facility deliveries, immunizations and curative care.[50] Some contracts focus almost exclusively on process measures such as immunization coverage rates in Haiti [59] or number of facility deliveries in Cambodia[60], while other models explicitly reward quality of care as in the case of Rwanda, Burundi and Egypt.[56, 57, 61, 62]

Improvements in facility outputs and quality for incentivized services have been reported by numerous projects but few have included appropriately designated control sites that allow for robust comparisons.[48, 52, 60, 63] Several evaluations of PBF projects have reported increased productivity, as measured by increased number of facility deliveries, immunizations given, family planning consultations and/or new contraceptive adopters, curative consults, etc.[54, 55, 64] Many of these evaluations have design constraints that weaken their findings. First, some of the evaluations have relied exclusively on health information system data reported by facilities that are incentivized to improve their reporting.[57, 59, 60, 63-65] Second, a number of studies examine changes only in PBF sites, with no comparison group or means of controlling for changes in the health environment that may influence uptake of services.[57, 64] Lastly, in an effort to tease out the effect of PBF from other concurrent changes, some studies have identified control sites, however, frequently these comparison groups are convenience samples and rarely are the intervention and control site assignments randomized. While there are analytic techniques available to surmount this lack of randomization, none of the studies reviewed employed these, instead trend comparisons dominate the literature.[65, 66] Notable exceptions include the experimental designs employed for the scale-up in PBF in Rwanda[61], the comparison of contracting methods in Cambodia[60], and the pilot project in Egypt.[56]

Rwanda was one of the first countries in sub-Saharan Africa to experiment with PBF. From 2002 to 2005, three PBF pilot projects covering approximately 2.6 million people (~32%) were implemented in Rwanda. Known as the Performance Initiative, these projects were designed to reverse a disturbing trend of decreasing health service utilization. User fees, initially abolished following the war, were reintroduced locally in the late 1990’s to provide some financing for extremely under-funded health centers after external post-conflict funding tapered off.[63, 67] By 2001, cost-sharing at the local level accounted for 60-80% of a facility's revenues, placing the lion's share of the funding on the population.[66] Many could not afford the new user fees and use of public health services dropped precipitously.[63, 66, 67] The fixed salaries and standard bonus payment system for health providers, meanwhile, provided no financial incentive to maximize productivity or extend the reach of services to the populations in need.[63, 67] The Performance Initiative was designed to incentivize providers to increase productivity within the public health system; quality of services was not part of the pilot payment scheme.

Evaluations of Rwanda's pilot projects' influence on increased productivity were promising. From 2001 to 2004, Meessen and colleagues reported dramatic increases in facility deliveries, family planning adoption, and tetanus toxoid delivery to pregnant women served by health centers in two pilot districts, Gakoma and Kabutare, compared to far less dramatic changes in health centers outside the pilot districts.[67] Corroborating these findings, Rusa and colleagues compared service use before and after pilot implementation and found increased uptake of family planning, facility deliveries, and measles immunization from health centers in contracting districts compared to non-contracting districts.[63] However, neither of these evaluations was able to isolate the impact of the Performance Initiative from pre-existing conditions at the intervention sites nor from other national reform efforts underway. Specifically, the pilot districts were not randomly selected, rather there were features in place that created a promising environment for intervention, including upgraded facilities with adequate supplies and equipment, a track record of public use indicating access to and acceptance of the health system, a functioning health information system, and involvement by foreign aid groups that set the stage for a new broad reaching intervention.[63, 67] The features that led to program placement likely introduced endogeneity which was not controlled for in the evaluations. Additionally, national efforts to decrease demand-side barriers, such as community-based insurance programs, equity funds for the poor and local inputs from community groups, were not controlled for in basic comparisons of percent increase in service use. Lastly, data from the facilities' health information systems were used to evaluate changes in service utilization. This was the primary source of data used to calculate incentive payments thus intensive capacity building efforts focused on improving the information systems in the pilot districts, without comparable efforts made in the non-contracting districts. It is not unreasonable to expect that an incentive based on reporting of services provided will increase the completeness of reporting and, some would argue, the inflation of reporting. Although independent surveys by the School of Public Health in Rwanda did validate the reported data from the intervention sites[67], qualitative interviews in one district following national expansion, revealed some evidence of inflated reporting.[58]

In 2005, PBF was adopted by Rwanda as a national health financing strategy. Based on lessons learned from the pilot PBF projects, the GoR defined a universal set of 14 process indicators, 9 quality weights and an algorithm for determining facility incentive payments based on indicator performance and weighted by quality of care measured across 14 different services (see Appendix A.1 for complete list of indicators, payments and weights).[61, 63] An additional set of indicators were specifically adopted for district hospitals and for HIV services as detailed elsewhere.[68] The accompanying capacity needed to manage PBF at the district level, such as health reporting systems, contract management services, assessment tools and supervisory structures, were identified. Finally, the decision to evaluate the impact of PBF on health service utilization and quality was made prior to scale-up, resulting in a phased implementation approach designed for evaluation. In collaboration with researchers from the School of Public Health, the Ministry of Health, and the World Bank, districts not involved in the pilot projects were matched on population density, rainfall and livelihood. Matched districts were then randomly assigned to Phase 1 or Phase 2. Phase 1 districts (n=12) transitioned to PBF models between January 2006 and November 2007, with the first PBF payment in June 2006. Phase 2 districts (n=7) began transitioning in April 2008. The remaining 11 pilot districts transitioned to the national program during Phase 1 but were not included in the subsequent evaluation. This phased implementation supported a more rigorous impact evaluation that controlled for program placement and effectively designated matched districts as the counterfactual, allowing for comparisons between what did happen in implementation districts and what might have happened in these sites if the program had not been implemented.[61]

For the impact evaluation, data were collected on use of maternal and child health services from household surveys and client exit interviews in a pre-post evaluation design. Quality of ANC services was measured in the household survey by maternal receipt of tetanus toxoid while assessment of quality at the facility relied on the quality index measure developed per GoR clinical protocols and used to determine payment. Increased input-based funding was provided to the control sites in an effort to determine the impact of incentive-based payments on service productivity and quality compared to a lump sum general budget increase. A difference-in-differences analysis controlling for facility fixed effects as well as individual and household covariates was used to estimate changes in service use attributable to the PBF program. Basinga and Gertler found a compelling 23% increase in use of facility deliveries, and an increase in use of child preventive care visits for both young children (56% for 0-23 month olds) and older children (132% for 24-59 month olds), yet no differences were found in number of ANC visits or in childhood immunization uptake.[61] The quality of ANC care provided at intervention sites was found to be significantly higher compared to control sites despite no difference in knowledge and training, supporting the claim that incentives encourage the extra effort needed to provide comprehensive care.[61]

Basinga and Gertler posit that incentive-based payments have a positive effect on services most incentivized and where providers exert more control, such as quality of services rendered at a visit, compared to outcomes that require repeat initiative by the client to seek out services, for example multiple ANC visits or childhood immunizations. Per the schedule of output indicators and quality weights, facility deliveries and obstetric referrals are the most highly incentivized services and the quality of prenatal services along with the quality of facility deliveries account for over 25% of the total quality score. Selective outreach to pregnant women for a one-time delivery and attention to quality for these services can reap large benefits for health centers and providers. Childhood immunizations on the other hand, require repeat visits by the client yet incentives are only awarded for completion of the recommended full schedule rather than for each shot administered. The quality weight for immunizations accounts for less than 10% of the total facility weight and the payment for a completed schedule is less than a dollar.(Appendix A.1) Family planning services are well incentivized for new adopters ($1.83) and account for 11% of the quality score, however evaluations have shown mixed results for use and no assessment of quality.[62, 63, 67] Curative care visits have low per-visit incentives ($0.18) yet the quality score for curative care accounts for 17% of the overall weight. Again, results for increased curative care visits are mixed, and the quality of these services have not been independently evaluated.[63, 67]

Basinga and Gertler argue that supply-side incentives can positively impact quality of services and additionally increase use of services if strongly incentivized and within the control of the provider. Understanding the effects of PBF on less incentivized services both the quality and the use, will better inform adjustments to the strategy as Rwanda moves forward.

Advocates hail PBF as a potential reform strategy that may profoundly influence the provision of health care through greater local provider autonomy under strong national oversight, [51] praise it as a flexible financing strategy that is responsive to country context and evolving health priorities, [69, 70] and promote it as an effective strategy for increasing service use. [36, 59, 61] Critics on the other hand, raise concerns regarding the limited empirical evidence for PBF, specifically the effect on equity of service use, on health outcomes not just service outputs, on the potential adverse effects for non-incentivized services, and on the long term impact and sustainability of this approach.[71-74] Recognizing the legitimacy of these concerns, the building of an evidence base for PBF in lower and middle income countries remains a priority.

Chapter 2

Research Aims and Methods

The PBF program implemented in Rwanda was designed to increase provider output thereby increasing health service utilization particularly for maternal and child primary health care. This study examines the question of whether a PBF program can help close the equity gap in use of maternal and child health services when there are no specific provisions to target the poorest in the population.

This proposed work builds on a prior impact evaluation work for PBF in the following ways. First, the intent of PBF in Rwanda is to increase provider output thereby increasing health service utilization for maternal and child services; however, historical use of services has been inequitable for the poorest in the population. This work will focus on the differential impact of PBF on service utilization among the poor to assess whether the PBF program is pro-poor. Second, speculation about the possible detrimental effects to less-incentivized services or non-incentivized services, have been raised.[75] This evaluation in part will examine child curative care which is less incentivized under PBF and will look at the pro-poor effect for curative care. Third, this evaluation will demonstrate the feasibility of using routine, national survey data for national program evaluations. Impact evaluations are critical to our understanding of the actual effect of new interventions such as PBF; however, extensive data collection solely for the sake of program evaluation is at times prohibitively expensive. The use of existing national survey data would help reduce costs and minimize duplication of efforts. Lastly, additional examination of successful PBF programs in sub-Saharan Africa provide evidence of best practices that Rwanda can incorporate to improve their model and countries looking to replicate Rwanda's model can benefit as well.

Aims and Hypotheses

This evaluation seeks to determine whether the Rwanda's PBF program differentially influenced the use of select, preventive and curative health care services among the poorest women and children. The following specific aims are addressed:

Aim 1: To determine whether the effect of PBF on the use of maternal health services in Rwanda varies by household wealth status.

Hypothesis 1A. The probability of receiving an adequate number of ANC visits and early ANC visits increased more from 2005 to 2007 among the poorest women living in districts financed through PBF compared to the least poor women living in PBF districts and relative to women living in control districts.

Hypothesis 1B. The probability of delivering in a health facility increased more from 2005 to 2007 among the poorest women living in districts financed through PBF compared to the least poor women living in PBF districts and relative to women living in control districts.

Hypothesis 1C. The probability of adopting modern contraception increased more from 2005 to 2007 among the poorest women living in districts financed through PBF compared to the least poor women living in PBF districts and relative to women living in control districts.

Aim 2: To estimate the effects of PBF on illness and responses to illness for children from varying economic strata in Rwanda.

Hypothesis 2A. *The probability of a child sick with diarrhea, fever, and/or symptoms of acute respiratory infection (ARI) is negatively associated with the adoption of PBF by the district.*

Hypothesis 2B. *The probability of reported illness with diarrhea, fever, and/or symptoms of ARI decreased more from 2005 to 2007 among the poorest children living in districts financed through PBF compared to the least poor children living in PBF districts and relative to children living in control districts.*

Hypothesis 2C. *The probability of a child sick with diarrhea, fever, and/or symptoms of ARI receiving consultation from a health facility is positively associated with the adoption of PBF by the district.*

Hypothesis 2D. *The probability of seeking consultation from a health facility when sick with diarrhea, fever, and/or symptoms of ARI increased more from 2005 to 2007 among the poorest children living in districts financed through PBF compared to the least poor children living in PBF districts and relative to children living in control districts.*

Hypothesis 2E. *Among those children reporting diarrhea or fever who received care from a health facility, the probability of receipt of ORT or antibiotics for diarrhea or a fever reducer or anti-malarial medication for fever, is positively associated with the adoption of PBF by the district.*

Conceptual Framework

Andersen's Behavioral Model of Health Services Use was first developed in 1968 to explain the use of formal health care services.[76] The intent was to provide a theoretical framework for understanding the use of and access to services in order to assist with the development of policies that promoted equitable use of health services.[76] The core of the model is built around the assumption that population characteristics, classified as *predisposing* *characteristics*, *enabling factors*, and *need for services* contribute to one's decision to seek health care. In 1995, Andersen unveiled the fourth iteration of this model which expanded to include consideration of the environmental context as well as the outcomes of service utilization, including health outcomes and service use experiences, that may influence decisions for subsequent service use.[76] The conceptual model (Figure 2.1) illustrates Andersen's Behavioral Model of Health Services Use populated with variables of interest for preventive and curative care seeking in Rwanda. For the purposes of this study, the analyses focused on the predisposing characteristics, enabling factors, and need that lead to use of health services, with some consideration of prior health service utilization.

Predisposing characteristics are those individual and household factors that might predispose one's need for health services and the use of those services. These are the factors that might influence someone's desire to seek care. Numerous studies have identified socio-demographic predictors for maternal and child health service utilization, including age, education, marital status, and parity/birth order.

Enabling factors are those characteristics at the household or community level that may facilitate or impede one's use of services. Typical considerations include financial and geographic access to services, such as family economic status, health insurance, rural or urban residence, and distance to health facilities. By 2007, over 85% of the DHS surveyed population lived within 5 kilometers of a facility and 100% lived with 10 kilometers, hence geographic access is assumed to be adequate.

Need for services is dependent on the service and on the assumptions one makes about need for skilled care. In the case of deliveries and curative care, the choice to seek care is influenced by one's perception of need – is the delivery at risk for complications or is the child sick enough. From a population perspective, use of prenatal care and institutional deliveries is the goal for 100% of pregnancies in order to lower the incidence of maternal and neonatal mortality. Modern family planning methods are "needed" for any woman wishing to space or limit pregnancies. Preventive childhood services such as immunizations and Vitamin A supplementation are also recommended for the entire population. Need for curative care from a health facility is harder to estimate. First the need is conditional on a disease event, which as mentioned above is more likely among the poorer populations and the severity may be more likely among the poor as well due to inadequate initial response. Second, the perception of severity for the parent may be hard to measure and for the researcher impossible to determine on an individual basis. However at a population level, the operating assumption is that most of the children whose parents remember an illness were likely sick enough to warrant medical consultation and/or treatment.

Prior use of services and outcomes. One's entry into the formal health system, either through maternal or child health services, exposes one to health education opportunities and ideally positive health outcomes that would influence future use. Previous use of services may also be indicative of a more modern view of health care that influenced original and subsequent use. Early use of ANC and multiple ANC visits increases the probability of skilled birth attendants and facility deliveries in many countries.[77-82] In Rwanda, Chandrasehkar concluded that three ANC visits was the threshold providers should aim for because women with three visits were 4.6 times more likely to deliver in a facility and 7 times more likely if more than three ANC visits were reported.[37] Previous facility births as well as previous neonatal deaths have both been found to be predictive of subsequent contraceptive use, ANC attendance, and facility delivery.[78, 83] Skilled ANC care as well as facility deliveries have also been predictive of subsequent care-seeking for sick children.[84-86]

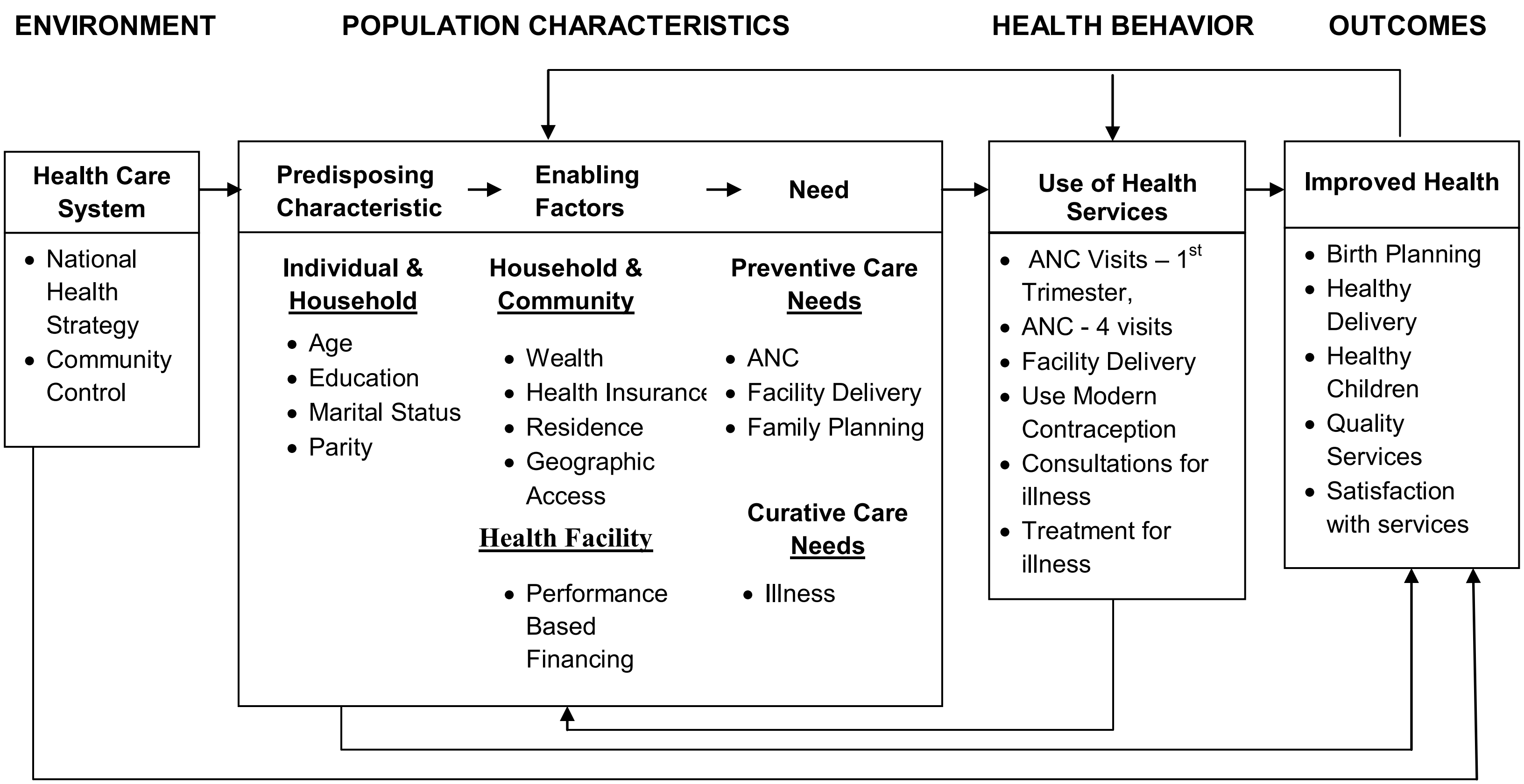

Figure 2.1. Conceptual Model

Study Setting and Design

The Republic of Rwanda, "Land of a Thousand Hills", is nestled in the highlands of the Great Lake region in eastern Africa. This small, landlocked country is home to approximately 11.4 million people, making it the most densely populated country in Africa.[87] Nineteen percent of the population lives in urban centers, with close to one million in the capital Kigali. The economy is driven equally by agriculture and services with each comprising approximately 42% of the Gross Domestic Product; the additional 14% is supplied by industry.[87] The vast majority (90%) of the population is engaged in subsistence farming, with some mining and agribusiness.[87]

The formal health sector in Rwanda is comprised of public health facilities, government-assisted health facilities or *agréés*, private health facilities and traditional healers. *Agréés* are private non-profit and faith-based health facilities that work within the public health system and have agreed to support the national health policies and abide by the protocols in place for the public facilities. In 2005, the combined number of public and *agréés* facilities was 385 health centers, 34 district hospitals and 4 national referral hospitals.[4] The private sector increased to more than 300 dispensaries and clinics, with over 50% of those located in and around Kigali.[4] The public sector health system provides a tiered system of facilities with health centers providing the primary point of access for comprehensive preventive and curative care. Health posts and dispensaries are one tier down, typically located in more remote areas and serving a smaller population with a minimum basic package of services. Hospitals are most typically a district referral resource with expanded capabilities for treatment and rehabilitation. There is at least one district hospital per administrative district while the four national hospitals serve as referral hospitals for the districts, providing more highly trained providers and specialized services.

The government's Health Strategic Plan for 2005-2009 set an ambitious plan to expand the use and quality of health services in Rwanda in an effort to meet the MDGs. Specifically the Plan included improving financial access to health services through increasing uptake of health insurance and increasing government expenditures on health; increasing human resources and geographic access for public health through infrastructure building, transportation support, PBF and training; and improving select maternal and child health outcomes through increased uptake of modern contraception, ANC and delivery care, as well as expanding the program for integrated management of childhood illnesses.[4]

In 2005, the government adopted a national performance-based financing (PBF) program for health centers and hospitals. PBF was designed to incentivize health facility personnel to increase health service productivity and improve service quality through special contracting at the facility-level. This supply-side incentive theoretically motivates providers and facilities to attract and maintain a client base in need of health services. Productivity is explicitly incentivized through a payment per health service provided, for example growth monitoring visits, facility deliveries, or tetanus toxoid immunizations. In Rwanda, the 14 incentivized services cover evidence-based primary maternal and child health services, both preventive and curative care (Appendix A.1; see Rusa[62] and Basinga[61] for details). In addition, service quality is assessed in a quarterly site visit and the quality score is used to weight the overall PBF payment, such that facilities receive a portion only of the performance payment if the quality score is not perfect. This contracting mechanism empowers providers, facilities, and the local health authorities to distribute these supplemental funds according to local priorities; typically provider bonuses as well as facility supplies and equipment, or local outreach efforts.

Prior to the national PBF scale-up, administrative districts not involved in earlier PBF pilot projects, were matched on population density, rainfall and livelihood. Matched districts were randomly assigned to early implementation between January 2006 and November 2007, or delayed implementation beginning in April 2008.[61] Health facility catchment areas map closely to administrative districts, such that when an intervention district adopted PBF, the district population theoretically gained access to intervention sites. This experimental design allows for comparisons over time between the early implementers or intervention districts and delayed implementers or control districts. National household survey data, collected independently from the randomized intervention, provide pre- and post-implementation measures for select child health outcomes.

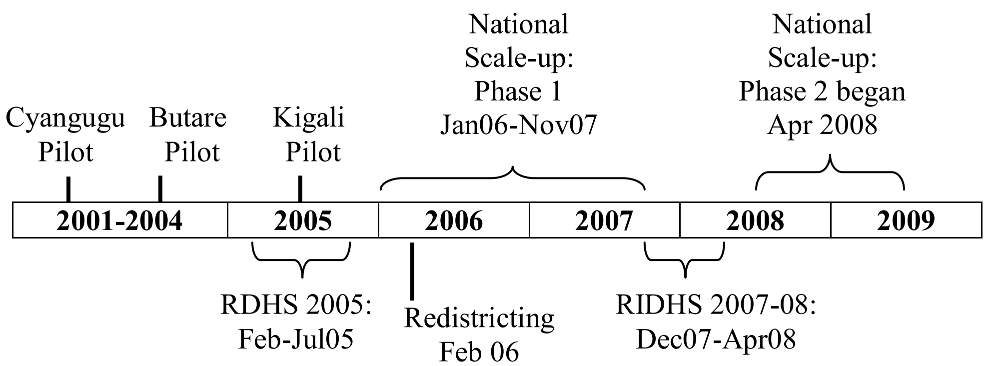

Figure 2.2. Timeline of PBF implementation and DHS data collection in Rwanda

Data

Demographic and Health Surveys

Data from the 2005 Rwanda Demographic and Health Survey (RDHS) and the 2007-2008 Rwanda Interim Demographic and Health Survey (RIDHS) provide individual and household socio-demographic characteristics and health indicators for maternal and child health, including ANC, birthing practices, family planning, immunizations, childhood illness, care seeking, and treatment received.

The 2005 RDHS employed a two-stage national sampling design to produce a sample representative of the 12 former provinces and stratified by rural and urban residence. Primary sampling units (PSUs) or clusters were selected from the 2002 General Population and Housing Census enumeration areas based on a probability proportional to the number of households within the enumeration area. Twenty households per urban cluster (111 clusters) and 24 households per rural cluster (351 clusters) were randomly selected. Within each participating household, one household survey was completed plus all women 15-49 years of age who were usual residents of the house or who slept in the house the previous evening were eligible for interviews. In total, 462 clusters were sampled, 10,272 households completed interviews (99.7% response rate), 11,321 women completed interviews (98.1% response rate), and data on 8,715 live births during the preceding five years and 8,649 children under the age of five was provided.[13] Individual sampling weights are included in the dataset to ensure that the sample is nationally representative.[13]

The 2007-2008 RIDHS selected 250 of the clusters that were sampled in the 2005 RDHS. These 250 clusters were sampled with probability proportional to size, and representative at the national and provincial level, both the former 12 provinces and subsequently the new 5 provinces formed in 2006. To assure reliable estimates for the urban areas and robust estimates for indicators at the provincial level, urban clusters were slightly over-sampled and 30 households were randomly selected from all clusters. One cluster was excluded from the surveying when it was found to be a refugee camp. In total, 249 clusters were sampled, 7,377 households completed interviews (99.5% response rate), 7,313 women completed interviews (97.1% response rate) and data on 5,656 live births in the preceding five years and 5,489 children under the age of five was provided. Individual sampling weights are included in the dataset to ensure that the sample is nationally representative.[14]

Geographic coordinates were available for 246 of the clusters, facilitating the creation of a panel dataset of matched clusters from 2005 and 2007. Eleven pilot districts, including the three districts surrounding Kigali, were excluded from the analysis, eliminating 96 clusters. Longitudinal data from a total of 150 clusters were thus used in the analysis, with 86 clusters from the 12 intervention districts and 64 from the 7 control districts. Details on the study sample of women and children for each analysis are presented in chapters 3 and 4, respectively.

Using DHS data is advantageous because it allows one to look at the effect in the population rather than relying on data from facilities that are incentivized to improve reporting. Three factors facilitate the use of DHS data for this evaluation: a) the random assignment of program implementation at the district level; b) the close match between district boundaries and facility catchment areas post-decentralization; and c) the timing of the two DHS, book-ending the implementation for intervention districts.

Health Facility Data

The Ministry of Health hosts a database of public health facilities on their website, with geographic location (GPS coordinates) for health centers and hospitals. Figure 2.3 shows the phased implementation of the PBF program, the health facilities and DHS clusters. At baseline, there were 79 facilities located in intervention districts and 86 facilities in control districts.[46]

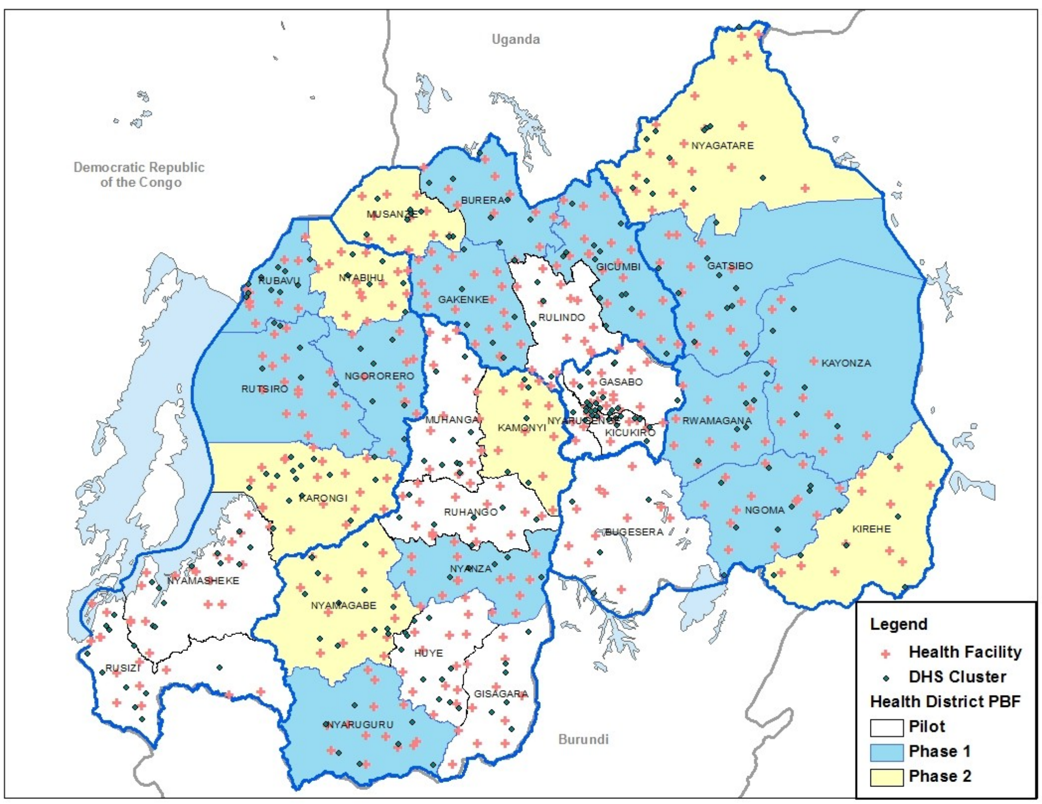

Figure 2.3. Districts by PBF implementation phase, Rwanda 2006

Statistical Approach

The approach described below applies to the analyses for maternal and child health service use. Details specific to each analysis are included in chapters 3 and 4 respectively.

Bivariate descriptive analyses of baseline population characteristics and for each outcome variable by year and wealth quintile were completed. Concentration curves plotting the cumulative outcome variables by the cumulative percentage of women ranked by wealth were created to graphically illustrate inequity in service use by wealth status. [88] Concentration curves were also created for child use of services but were not very revealing, hence they are not presented.

A difference-in-differences (DD) estimation strategy was used to evaluate the impact of PBF on the use of primary health services. The DD estimator calculates the change in mean outcome (Y) for the intervention and control groups over time and takes the difference between the groups to determine the effect of PBF, written as:

Equation (1): $DD = (Y_{PBF07} - Y_{PBF05}) - (Y_{Non-PBF07} - Y_{Non-PBF05}).$

A linear probability model (LPM) was run for each outcome, with cluster-robust standard errors and individual, maternal, and household covariates included to reduce residual variance and improve the efficiency of the estimates. Community fixed effects were subsequently included to control for time-invariant unobserved community differences. The DD with community fixed effects specification is written as:

Equation (2): $Y_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 Y07_t + \beta_3 (PBF_j * Y07_t) + \mu_j + \varepsilon_{ijt},$

where subscripted indexes are defined as i=individual, j=community or cluster, and t=time. Terms in the model include the vector of covariates (X), a dummy variable for time period 2007/08 (Y07=1 for post-implementation), and a dummy program variable for clusters located in districts with performance-based financing (PBF=1 for intervention district, 0 for control). The primary coefficient of interest is β_3, which captures the effect of the PBF program on the outcomes Y. By subtracting the differences over time between program areas, the unobserved time-invariant community fixed effects (μ_j) will be differenced out. Unobserved time-varying community variables (μ_{jt}) are excluded from the model because community characteristics are unlikely to change dramatically during the short 2-3 year interval, any changes are likely to be minor, and the fixed community differences are already differenced out. Individual unobserved time-invariant fixed effects (μ_i) are also excluded because any potential bias due to omitted variables might arise at the community level where the program intervention was assigned, rather than the individual level.

Interaction terms between wealth quintiles and the PBF intervention were then estimated to identify the differential effect of PBF among women and children from poorer families. The model specification shown below is written with only one set of wealth interaction terms to illustrate the inclusion of the interactions.

Equation (3): $$Y_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 Y07_t + \beta_3(Y07_t * PBF_j) + \beta_4(Wealth1_{ijt}) + \beta_5(PBF_j * Wealth1_{ijt}) + \beta_6(Y07_t * Wealth1_{ijt}) + \beta_7(Y07_t * PBF_j * Wealth1_{ijt}) + \mu_j + \varepsilon_{ijt},,$$

where subscripted indexes are defined as i=individual, j=community, and t=time. Dummy variables for the wealth quintiles were added. Wealth1 represents the poorest 20% of households, additional terms for Wealth2, Wealth3, and Wealth4 were also included (though not shown), and the least poor, Wealth5, served as the referent group. The primary coefficient of interest (β_7), is for the triple interaction which captures the effect of the PBF program on the probability of the outcome among women/children from the poorest households compared to the probability of the outcome among women/children from the least poor households, relative to women/children living in control districts. Interaction terms between insurance status and PBF residence, and insurance with wealth quintiles were also tested.

Additionally for the woman's analysis, the models were stratified by residence to identify any difference in program effect in rural versus urban settings that were not revealed in the full model when residence was differenced out by the community fixed effects specification. However due to the minimal number of urban clusters (n=22) and the allowance for intracluster correlation, correct cluster-robust standard errors will not be produced with more than 21 variables in the model. Hence the number of covariates was restricted for the stratified models to those considered most influential as noted in the results.

For the child analysis, marginal effects for each population group of interest – intervention group, control group, poorest in intervention, wealthiest in intervention, etc – were calculated to illustrate the changes in the selected outcomes over time by group. Stratification by residence was not possible due to the smaller sample.

All analyses were completed in Stata SE 11.2 (StataCorp, College Station, TX).

Chapter 3

Are Maternal Health Services Reaching the Poorest Women?

The aim of this analysis is to examine the effects of PBF on equity in maternal health service use. Specifically, in the absence of provisions targeting the poor, does PBF increase health service use differentially among the poorest women?

Study Sample

The panel dataset of 150 clusters included 7,899 women 15-49 years of age who lived in either an intervention (4,477) or control district (3,422); 3,611 women from the 2005 data and 4,288 from 2007. Three pregnancy-related outcomes were studied: early initiation of ANC, four or more ANC visits during pregnancy, and delivery in a health facility. The window of analysis for these outcomes was limited to deliveries in the previous 18 months to isolate the effects of PBF. The final dataset for pregnancy-related outcomes included 2,044 women; 1,170 from intervention districts and 874 from control districts. The fourth outcome studied was use of modern contraceptives among married women. This final dataset included 4,121 currently married woman; 2,328 from intervention districts and 1,793 from control districts.

Measures

The four dependent variables, early initiation of ANC, four or more ANC visits during pregnancy, delivery in a health facility and use of modern contraceptives, were collected in each DHS. For this evaluation, receipt of formal ANC services includes women who reported receiving prenatal care from a trained medical provider in a public or private health facility. WHO recommends four or more ANC visits and early initiation of care, defined as any visit before the 4th month of pregnancy.[89] Facility deliveries include delivery in any public or private health facility, and are promoted worldwide as a key strategy to reduce maternal mortality. Modern contraception was limited to pills, injectables, implants, or IUDs, as these methods were specifically promoted under PBF. Each of these outcomes is incentivized through PBF, although the payment rate varies by service, with the highest monetary incentive for a facility delivery.

The key independent variables are residence in a PBF intervention or control district and household wealth. Assignment to a PBF intervention district was based on the district in which the survey cluster was located; hence all women from the same cluster were assigned the same PBF status. Household wealth scores based on asset ownership and housing characteristics were created separately for the 2005 and 2007 study samples. Polychoric principal component analysis (PCA) was used to calculate a wealth score that maximized the contribution of binary and categorical variables.[90] The choice of assets for the wealth score was based on the economic context in Rwanda and data availability. Assets for 2005 included television, radio, telephone, bicycle, and land ownership; housing characteristics included electricity, drinking water, toilet facility, cooking fuel, and flooring material. Three assets were excluded due to perfect prediction with other assets: refrigerator, motorcycle, and car. For 2007, land ownership data was not collected, car and motorcycle ownership were combined as a single variable, and refrigerator was excluded, again for reasons of perfect prediction. The first component of the polychoric PCA was used to create the wealth index score, explaining 59% of the variance for 2005 and 57% for 2007. Households were divided into quintiles based on their wealth index score; the new wealth quintile was assigned to each woman living in the household.

Selection of the covariates was dependent on the outcome variable. For all four outcomes, covariates included age, education, marital status, parity, insurance and prior facility birth within past five years. Additionally for the facility delivery outcome, ANC visits were included, and for the modern contraception outcome, history of a previous child death in the family was included.

Results

Comparison of the intervention and control study populations at baseline indicates that the random assignment of districts to intervention phase created comparable populations with no significant differences (Table 3.1).

Table 3.1 Woman and household characteristics by intervention and control samples at baseline, 2005 RDHS weighted data

	Total		**Intervention**		**Control**			
Characteristics	(n=3,613)	%	(n=2,227)	%	(n=1,386)	%	Diff.	p-value
Age < 20 years	743	20.6	469	21.1	274	19.8	1.29	0.368
Age ≥ 35 years	359	9.9	218	9.8	141	10.2	-0.38	0.704
Primary School	618	17.1	375	16.8	243	17.5	-0.69	0.760
Married	1832	50.7	1124	50.5	707	51.0	-0.54	0.825
Parity: No Births	1309	36.2	815	36.6	495	35.7	0.88	0.659
Parity: More than 5	774	21.4	481	21.6	293	21.1	0.46	0.776
Wealth Status								
Poorest	737	20.4	476	21.4	262	18.9	2.47	0.310
Poorer	775	21.5	442	19.8	333	24.0	-4.18	0.115
Middle	678	18.8	414	18.6	264	19.0	-0.46	0.814
Less Poor	718	19.9	452	20.3	265	19.1	1.18	0.597
Least Poor	704	19.5	442	19.8	262	18.9	0.94	0.799
Health Insurance	1768	48.9	1051	47.2	717	51.7	-4.54	0.248
Rural Residence	3302	91.4	2051	92.1	1251	90.3	1.84	0.653
Prior Facility Delivery	203	5.6	121	5.4	83	6.0	-0.56	0.521

The concentration curves (Figures 3.1-3.4) plot the cumulative share in service use by wealth status for 2005 and 2007. Women by wealth quintile are plotted on the x-axis with the poorest women located in the lower left. The cumulative outcome variable is plotted on the y-axis. The line of equity is achieved when the use of the service is equal across wealth quintiles. A line below the line of equity indicates the outcome has lower values among the poorer women in the population. The equity gap in 2005 is most evident for use of modern contraception, with 60% of the poorest women reporting less than 40% of the share of modern contraceptive use (Figure 3.4). Likewise facility deliveries were more often reported among the wealthier in 2005 (Figure 3.3). By 2007, the gap in equity for all four outcomes decreased.

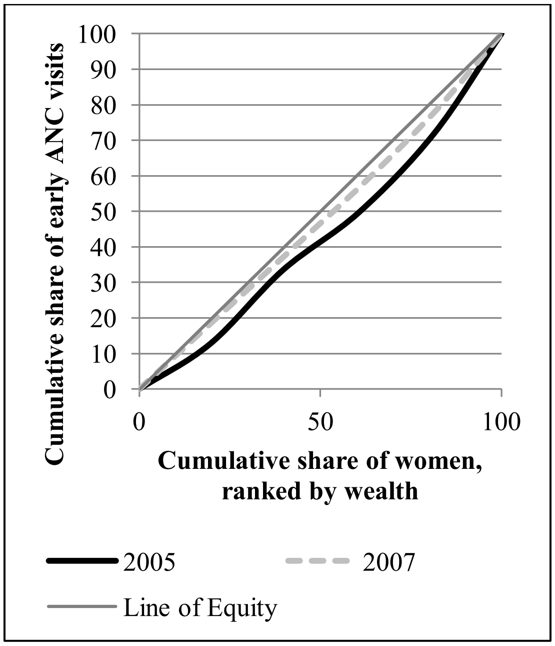

Figure 3.1. Concentration curve: Early ANC

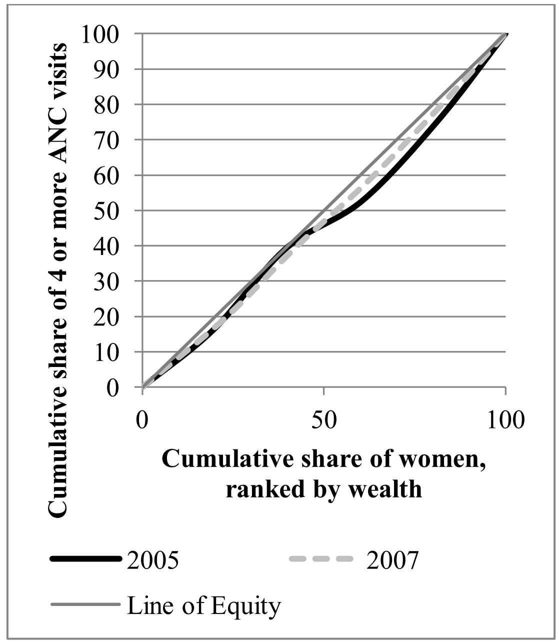

Figure 3.2. Concentration curve: ≥ 4 ANC

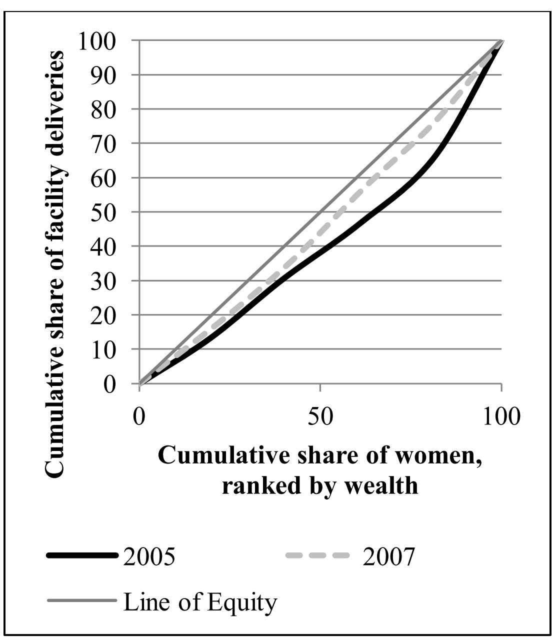

Figure 3.3. Concentration curve: Facility Birth

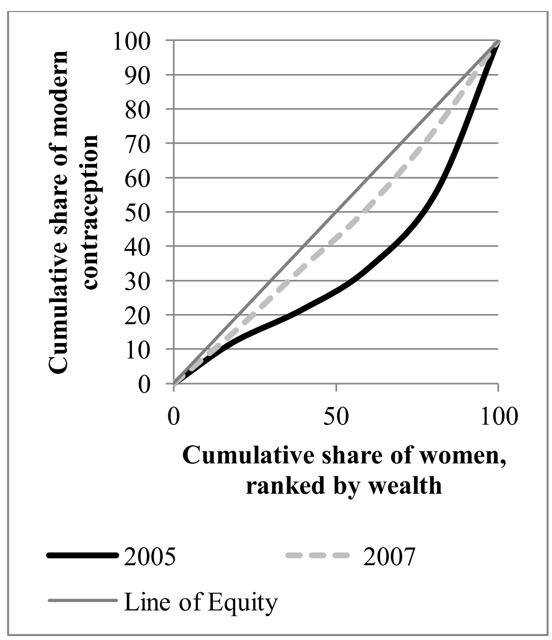

Figure 3.4. Concentration curve: Contraception

The absolute change in service use improved from 2005 to 2007 for all four outcomes (Table 3.2). The most dramatic improvements were measured for facility deliveries among the intervention and control groups, 36.0 and 19.9 percentage-point changes respectively. For ANC visits and contraceptive use, average service use improved approximately 14 percentage points from 2005 to 2007.

Looking at disparities, the inequity of facility deliveries seen in 2005 between the least poor 20% of the population compared to the poorer 80% of the population is substantial for the intervention and control groups. By 2007, improved use by the middle income groups narrowed this gap in facility deliveries. A similar pattern is seen for modern contraceptive use in 2005 where use doubles among the least poor quintile compared to the poorer 80%. This disparity by wealth is much less evident for early ANC initiation and nearly non-existent for meeting the recommended number of ANC visits.

Modern contraceptive use was twice as high among urban versus rural residents in 2005, a pattern seen also for facility deliveries. In absolute terms, the improvements between 2005 and 2007 for urban and rural residents were similar for modern contraceptives and facility deliveries. By 2007, approximately one-quarter of the women reported early ANC and adequate number of ANC visits, with no clear differences between rural and urban communities.

Comparisons of absolute changes between PBF intervention and control groups between 2005 and 2007 suggest that PBF may have positively influenced the increased use of facility deliveries. However, no consistent patterns of higher service use are evident for intervention versus control populations for ANC visits or modern contraceptive use. Further analyses using econometric techniques provides an opportunity to control for unmeasured influences or programs that may have contributed to the changes seen, hence offering insights into the effect of PBF particularly among the poor.

Table 3.2. Percent of women reporting key outcomes by study sample and year

Key Outcome		Intervention Group 2005	Intervention Group 2007	Intervention Group Absolute Change[1]	Control Group 2005	Control Group 2007	Control Group Absolute Change[1]
First Trimester ANC[2]		7.2	23.8	16.6***	6.6	20.0	13.4***
Wealth:	Poorest	6.2	20.0	13.8	1.2	22.1	20.9**
	Poorer	8.8	17.5	8.7	5.0	25.4	20.4**
	Middle	5.4	25.6	20.2***	5.3	13.6	8.3
	Less Poor	6.1	25.0	18.9***	10.2	19.8	9.6
	Least Poor	10.5	31.7	21.2	10.7	18.3	7.6
Residence:	Rural	6.6	23.4	16.8***	6.9	19.5	12.6***
	Urban	16.5	28.6	12.1	4.3	25.1	20.8**
Four or more ANC[2]		13.3	24.6	11.3***	10.0	22.8	12.8***
Wealth:	Poorest	11.1	20.4	9.3	7.8	20.5	12.7*
	Poorer	18.7	26.2	7.5	7.2	22.1	14.9**
	Middle	7.2	23.5	16.3**	8.8	21.0	12.2*
	Less Poor	14.2	27.6	13.4*	11.2	22.4	11.2*
	Least Poor	16.5	26.2	9.7	15.3	29.2	13.9
Residence:	Rural	13.1	24.6	11.5**	10.2	22.8	12.6***
	Urban	16.6	25.2	8.6	8.8	22.3	13.5
Facility Delivery[2]		23.4	59.4	36.0***	28.8	48.7	19.9***
Wealth:	Poorest	17.7	44.2	26.5	16.0	45.6	29.6**
	Poorer	19.8	53.4	33.6***	24.3	43.7	19.4*
	Middle	18.8	64.2	45.4***	20.3	50.0	29.7***
	Less Poor	21.0	61.6	40.6***	29.1	44.6	15.5
	Least Poor	42.1	77.1	35.0	53.5	62.3	8.8
Residence:	Rural	22.1	57.8	35.7***	27.9	47.6	19.7**
	Urban	44.0	79.3	35.3*	35.3	61.4	26.1
Modern Contraception[2,3]		6.1	22.0	15.9***	6.8	23.3	16.5***
Wealth:	Poorest	3.8	18.4	14.6***	4.9	18.1	13.2**
	Poorer	2.3	18.0	15.7***	3.5	23.0	19.5***
	Middle	3.1	20.3	17.2***	4.9	17.7	12.8**
	Less Poor	6.7	23.9	17.2***	6.6	25.5	18.9***
	Least Poor	14.9	29.0	14.1**	14.4	31.7	17.3**
Residence:	Rural	5.6	21.2	15.6***	6.2	22.6	16.4***
	Urban	12.6	33.4	20.8*	13.8	30.7	16.9*

[1] T-tests for differences between 2005 and 2007. *p<0.05, ** p<0.01, *** p<0.001

[2] No statistical differences found between intervention and control groups at baseline.

[3] Modern contraception includes pill, injectable, implant and IUD.

Results from the LPM were used to obtain the difference-in-differences estimator for the effect of PBF on maternal health services (Table 3.3). The probability of a facility delivery increased by 10.0 percentage points in the intervention districts compared to the control districts (p=0.014), while no significant effects were noted for ANC visits or modern contraceptive use.

Table 3.3. Estimated effects of performance-based financing on service use (difference-in-differences estimate)

		Difference in service use in Intervention Districts		
Maternal Health Service	N	Coeff	(SE)	p value
First Trimester ANC Visit[1]	1,983	0.011	(0.037)	0.770
Four or more ANC Visits[1]	1,983	-0.053	(0.036)	0.145
Facility Delivery[2]	1,977	0.100*	(0.040)	0.014
Use of Modern Contraception[3]	4,050	0.010	(0.022)	0.641

[1] Covariates include wealth, age, education, marital status, parity, insurance, and prior facility birth within past five years.

[2] Covariates include wealth, age, education, marital status, parity, insurance, any ANC visits, and prior facility birth within past five years.

[3] Modern contraception includes pill, injectable, implant and IUD. Covariates include wealth, age, education, marital status, parity, insurance, previous child death, and prior facility birth within past five years.

Our primary question however, is whether PBF reached the poorest of the population, that is did PBF help close the gap in service use between the least poor and poorest women in Rwanda. Interactions between program effect and wealth quintile revealed no statistically significant differences (Table 3.4). For facility deliveries, no consistent pattern in use relative to household wealth status was found. The strongest predictors of facility delivery after controlling for PBF remain parity (β=0.408, p<0.001), prior facility delivery (β=0.368, p<0.001), and any ANC visits during index pregnancy (β=0.193, p<0.001), while health insurance contributes modestly (β=0.056, p=0.012) (data from full models in Appendix A.2, A.3). Receipt of four or more ANC visits increased among the poorer 80% of the population compared to the least poor, particularly for women in the middle (β=0.197, p=0.102) and the richer (β=0.139, p=0.217) wealth quintiles, although the results are not significant. No clear patterns emerge for either early ANC initiation or modern contraceptive use by wealth group.

Table 3.4. Estimated differential effects of performance-based financing by wealth on service use (difference-in-differences estimate with wealth interaction terms)

Effect of PBF by Wealth (Least Poor=Referent Group)	**First Trimester ANC Visit[1]** Coeff (SE)	**Four or more ANC Visits[1]** Coeff (SE)	**Facility Delivery[2]** Coeff (SE)	**Modern Contraception[3]** Coeff (SE)
PBF among Poorest	-0.062	0.091	-0.040	0.058
	(0.104)	(0.103)	(0.119)	(0.072)
PBF among Poorer	-0.097	0.048	0.102	0.022
	(0.113)	(0.122)	(0.114)	(0.072)
PBF among Middle	0.029	0.197	0.045	0.088
	(0.105)	(0.119)	(0.112)	(0.075)
PBF among Less Poor	0.051	0.139	0.020	0.056
	(0.117)	(0.112)	(0.123)	(0.073)
Number of Clusters	150	150	150	150
Number of Women	1983	1983	1977	4050

[1] Covariates include age, education, marital status, parity, insurance, and prior facility birth

[2] Covariates include age, education, marital status, parity, insurance, prior facility births and ANC visits

[3] Modern contraception includes pill, injectable, implant and IUD. Covariates include age, education, marital status, parity, insurance, prior facility birth and previous child death

Finally, the impact of PBF by wealth was estimated separately for rural and urban residence. First a DD model interacting with rural residence rather than wealth quintiles was run for each outcome (data not shown). No differences in program impact were found for rural versus urban residents for the four outcomes studied. Next the primary DD with wealth interaction terms was run for stratified rural and urban samples, results presented in Table 3.5. No clear patterns emerge in the stratified analysis, leading to the conclusion that PBF did not influence service use differentially by wealth or residence.

Table 3.5. Estimated differential effects of performance-based financing by wealth on service use, stratified by residence (difference-in-differences estimate with wealth interaction terms)

	First Trimester ANC Visit[1]		Four or more ANC Visits[1]		Facility Delivery[2]		Modern Contraception[3]	
Effect of PBF by Wealth	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**
(Least Poor =Ref. Group)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)
PBF among the Poorest	-0.147	0.012	0.087	-0.069	-0.018	0.096	0.082	-0.031
	(0.111)	(0.304)	(0.121)	(0.242)	(0.148)	(0.300)	(0.083)	(0.181)
PBF among the Poorer	-0.178	0.014	0.080	-0.642	0.122	0.022	0.034	0.054
	(0.122)	(0.327)	(0.138)	(0.327)	(0.143)	(0.337)	(0.084)	(0.196)
PBF among the Middle	0.071	-0.573*	0.224	-0.277	0.081	-0.012	0.114	0.073
	(0.115)	(0.254)	(0.129)	(0.298)	(0.151)	(0.189)	(0.086)	(0.190)
PBF among the Less Poor	-0.027	0.167	0.108	0.290	0.108	-0.379	0.089	0.009
	(0.129)	(0.212)	(0.124)	(0.259)	(0.152)	(0.231)	(0.088)	(0.146)
No. of Clusters	128	22	128	22	128	22	128	22
No. of Women	1733	302	1733	302	1682	296	3586	535

* p<0.10, **p<0.05

[1] Covariates limited to marital status, parity, and insurance.

[2] Covariates limited to parity, prior facility birth and any ANC visits.

[3] Modern contraception includes pill, injectable, implant and IUD. Covariates limited to parity.

Discussion and Limitations

To combat the pervasive low use of maternal health services in Rwanda in the early 2000s, the Government of Rwanda promoted both supply-side and demand-side financing strategies. Performance-based financing was scaled up nationally to increase the supply of health services through an incentive program for providers and health facilities. Meanwhile, community based health insurance rapidly increased to reduce financial barriers for consumers. Supporters for PBF recognized that increasing and improving service performance was not solely an issue of lack of provider knowledge or skills, [91] rather the government needed to target multiple facets of provider motivation to increase service output. Serneels and Lievens propose four institutional factors that influence health worker performance in Rwanda: incentives, monitoring arrangements, professional norms, and intrinsic motivations. [92] PBF, through a set of monetary incentives and increased supervision and monitoring, directly addresses the first two factors.

Indirectly, PBF may improve the professional norms or culture of a facility as colleagues begin to work together towards higher outputs and subsequently intrinsic motivations may improve as one takes pride in the improved performance of the facility. Basinga and colleagues found that the monetary incentives of PBF did increase the percentage of facility deliveries and the quality of ANC services provided in intervention sites, after controlling for the increase in absolute health expenditures (approximately 22%).[61] Our analysis confirmed some of these findings with national data collected independently of the intervention. In 2007, women living in intervention districts were 10.0 percentage points more likely to deliver in a health facility compared to women in control districts, a 42.7% increase in facility deliveries attributable to PBF.

This study took a step further and looked at whether PBF was an effective pro-poor strategy, increasing the use of maternal services among the poorest women in the population. No evidence was found that PBF is pro-poor in Rwanda, likewise we found no evidence that PBF is pro-rich. The increase in facility deliveries was seen across all wealth groups ranging from 26-45 percentage point increases among the intervention group compared to 8-30 percentage point increases among the controls (Table 3.2), yet interaction terms between wealth, year and PBF program found no differential effect of the program by wealth quintile. While the equity gap in service use for facility deliveries and modern contraceptive use decreased from 2005 to 2007; we cannot conclude that PBF was responsible for these improvements.

So why isn't PBF a pro-poor strategy in Rwanda? Often health facilities located in poorer communities are understaffed, poorly equipped, and less well organized, resulting in health services less responsive to the needs of the population.[27, 33] PBF was designed specifically to increase health service output and quality for a health system chronically understaffed. Inputs included financial incentives, training, supervision, and accountability through monitoring and reporting of services provided. A priori, one would anticipate improved quality of services that are more responsive to local needs, and subsequently an increased use of services in these facilities. Moreover, facilities had the authority to allocate incentive payments according to perceived need; provider bonuses, equipment replacement, and community outreach efforts all were options exercised by local leaders. Anecdotally we know that some facilities adopted outreach strategies to encourage facility use by women from poorer households, including waiving or reducing fees, offering transportation, and enlisting community health workers to refer women for services. However there were no specific provisions in the PBF incentive structure or the program placement that differentially targeted poorer households or communities; rather the program was rolled out uniformly to serve all Rwandans.

Given the widespread disparities in health service use between the least poor and poorest populations in sub-Saharan African, a fair question is why the Government of Rwanda did not design a PBF program that explicitly targeted poorer households. Following the war and genocide in Rwanda, maternal health indicators and service utilization was poor across the board. Estimated maternal mortality was very high, 1,071 deaths per 100,000 live births from 1994-2000.[93] Less than one third of deliveries were assisted by a trained birth attendant and only 27% reported delivery in a health facility. While over 90% of women reported at least one ANC visit during pregnancy, only 10% reported receiving the recommended four or more visits, and only 4% of married women reported modern contraceptive use, down from 13% in 1992, resulting in a 36% estimated unmet need for family planning in Rwanda. With such low service statistics in 2000, a national approach to improve services for everyone was warranted; particularly, one could argue, if levels of use among the poorest might continue to lag as long as the wealthiest were not achieving high levels of use.[94]

Rwanda however did not ignore the issue of equity, rather a demand-side effort was simultaneously undertaken to reach the poorer populations. Community-based health insurance (CBHI) improved dramatically during this time; reaching estimated levels of 73% coverage by 2006.[47] CBHI was developed in an effort to mobilize resources locally for health centers and to reduce the financial barriers and risks families faced with unexpected medical costs. Benefits cover a standard set of MCH services, such as family planning, antenatal care, deliveries, consultations, lab work and generic drugs. Participation requires an enrollment fee and annual premium, with the poorest in the community eligible for donor subsidies to cover premiums.[47] Analysis of 2005 data found that insured women were significantly less likely to deliver at home, and the odds of delivery at home significantly decreased as wealth status increased.[95] In another small scale study in Rwanda, outpatient visits increased significantly when insurance co-payments were waived, arguing that any point-of-service payment is a barrier to use among the poorest.[96] In our analysis, additional interaction terms with health insurance (insurance and wealth, insurance and PBF) found no evidence of the effect of insurance operating differently in PBF districts or by wealth group (data not shown).

A few study limitations merit mention here. This study purposively used national household survey data that was collected independently of the PBF program, in an effort to reproduce findings from an earlier program evaluation and to explore different household characteristics that may not have been collected in facility statistics or the evaluation survey. However, relying on national datasets means certain constraints to the analyses. First, the window between data collection periods for the 2005 and the 2007-08 surveys was only 29 months and initial PBF payments for intervention districts did not begin until 11 months into that window, effectively shrinking the intervention period to 18 months. This period may be too short to measure some program effects.

Another potential limitation is the structure of the panel dataset. The survey design re-sampled the 2005 clusters in 2007, but individuals were not re-interviewed. The models difference out the time-invariant unobserved community-level characteristics, but do not include individual-level fixed effects because the individuals change between surveys. Three of the individual-level control variables, health insurance, prior facility delivery, and any ANC visits are “choice” variables indicative of some underlying propensity to choose insurance or choose to use services. However, assignment of the PBF program was random at the community-level, irrespective of individual characteristics so there is no reason to suspect that PBF program placement is correlated with individual insurance or use of services. In fact, models run with and without these choice variables produced very similar coefficients. The inclusion of these individual covariates merely improved the efficiency of the estimates.

Finally, the creation of asset-based wealth scores was limited by the questions fielded on the 2005 and 2007-08 DHS. Asset-based indices remain the standard when income and expenditure data are not available, yet more researchers are calling for separate rural and urban scales.[97-99] Unfortunately, rural-specific assets such as livestock and land ownership were not collected in both surveys, limiting our ability to create separate rural/urban scales. This prompted stratification by residence; however the limited number of urban clusters reduced the power to detect differences. The trend in DHS is now to collect asset information that will allow a refinement of wealth quintiles in rural areas.

Chapter 4

Impact of PBF on Care-Seeking and Treatment for Childhood Illness

The goal of this analysis is to estimate the effects of performance-based financing on the prevalence of illness and the response to these illnesses for children in Rwanda. More specifically, we explore the effect of PBF by household poverty, testing hypotheses that support a narrowing of the equity gap in childhood illness and service use between children from the poorest and the least poor households.

Study Sample

The panel dataset of 150 clusters included 5,781 children less than 5 years of age who lived in either an intervention (3,307) or control district (2,474). Slightly over half of the children were from the 2007 survey, 3,157 (54.6%).

Measures

Three primary outcomes were studied: prevalence of childhood illness, care-seeking at a health facility for the reported illness, and treatment received among those who sought care at a facility. In this analysis, care-seeking is reported as success in actually receiving some care at a facility, therefore it does not include those who may have tried to obtain care at a facility and failed. Data for reported cases of diarrhea, fever, and symptoms of acute respiratory infections (ARI), care sought for these episodes, and treatment received were collected in 2007; treatment information for ARI was not collected in 2005. Across each survey year, fewer than 30% of the children reported individual illness with diarrhea, fever, or ARI in the preceding two weeks;

subsequent care-seeking narrows the sample as less than 40% of the ill children reported seeking facility care. To maximize the data available, reported illnesses were combined as described below.

In the DHS surveys, caregivers were asked if any child in the home was ill with diarrhea, fever, and/or a cough with short, rapid breathing (symptoms of ARI) in the previous two weeks. Responses were combined into two dichotomous illness variables: illness with diarrhea, fever and/or ARI; and illness with diarrhea and/or fever, excluding ARI. This allowed the creation of data subsets for those ill including ARI (n=2,073) and those ill excluding ARI (n=1,742). Questions regarding treatment received were asked only of the latter group in both survey years. Caregivers who reported a sick child were subsequently asked whether advice or treatment was sought from any source. Among those who sought advice a follow-up question asked "Where did you seek advice or treatment?" All those who reported advice sought from public or private hospitals, health centers, clinics or health posts were coded as seeking care at a health facility. Among those reporting illness with diarrhea and/or fever, a series of follow-up questions were asked to identify any treatment or medications administered, either at home or a facility. A dichotomous variable for treatment received was constructed: "yes" if a child with diarrhea received oral rehydration salts, recommended home fluids, increased fluids, and/or antibiotics or if sick with fever then receipt of fever reducer and/or an anti-malarial; all other responses were coded "no".

The key independent variables are residence in a PBF intervention or control district and household wealth. Assignment to the PBF intervention and control groups, as well as development of wealth scores, was done at the household level as described in chapter 3. Selection of the covariates was dependent on the outcome variable. For all outcomes, covariates included child's age, birth order, gender, facility birth, maternal age, maternal education, marital status, and household wealth. Additionally for the two illness outcomes, toilet facilities, drinking water sources, and bednet ownership were added; for care-seeking and treatment outcomes, health insurance status and history of a previous child death in the family were included.

Results

The random assignment of districts to intervention phase successfully created comparable intervention and control populations, with no significant differences between groups at baseline (Table 4.1). Furthermore, no statistical differences in reported illness, care-seeking or treatment received were found at baseline between the intervention and control populations (Table 4.2).

Table 4.1. Comparison of mother and household characteristics between the intervention and control samples at baseline, 2005 RDHS weighted data

	Total		**Intervention**		**Control**		**Difference**	
	(N=2619)	%	(N=1631)	%	(N=988)	%	Perc.Pt	p-value[1]
Child								
Age < 12 months	590	22.5	376	23.0	214	21.6	1.40	0.406
Sex: Boy	1333	50.9	843	51.7	489	49.5	2.20	0.289
Birth Order: 1st Birth	439	16.7	275	16.9	164	16.5	0.40	0.846
Birth Order: ≥ 5th	988	37.7	632	38.7	356	36.0	2.70	0.335
Slept under Bednet	277	10.8	179	11.2	97	10.1	1.10	0.621
Health Facility Birth	586	22.4	348	21.4	238	24.1	-2.70	0.409
Mother								
Age < 20 years	497	19.0	336	20.6	161	16.3	4.30	0.064
Age ≥ 35 years	386	14.7	239	14.6	147	14.9	-0.30	0.886
Primary School grad.	445	17.0	275	16.8	170	17.2	-0.40	0.881
Married	1310	88.2	1429	87.6	881	89.1	-1.50	0.380
Previous Child Death	1126	43.0	714	43.8	412	41.7	2.10	0.495
Household								
Wealth: Poorest	498	19.0	318	19.5	180	18.2	1.30	0.619
Wealth: Poorer	534	20.4	296	18.1	238	24.1	-6.00	0.050
Wealth: Middle	548	20.9	367	22.5	181	18.3	4.20	0.109
Wealth: Less Poor	525	20.0	342	21.0	182	18.4	2.60	0.326
Wealth: Least Poor	515	19.6	308	18.9	206	20.9	-2.00	0.608
Health Insurance	1283	49.0	771	47.3	512	51.8	-4.50	0.364
Rural Residence	2399	91.6	1523	93.4	876	88.6	4.80	0.254
Improved Toilet[2]	610	23.3	338	20.7	272	27.5	-6.80	0.077
Clean Water Source[3]	871	33.2	601	36.9	269	27.3	13.50	0.066

[1] T-tests comparing proportions between intervention and control groups
[2] Includes flush toilets and improved latrines
[3] Includes tap water and water from improved wells

Comparison of the absolute change in reported diarrhea, fever, and ARI from 2005 to 2007 shows a decline in illness for both the intervention and control populations, although significant only among the intervention group for fever (-5.6 percentage point decline, p=0.018) (Table 4.2). Improvements were seen in care-seeking behavior among those with reported diarrhea or fever, while consultations for ARI were inconsistent across study groups, with a decline in visits among the intervention group and an increase in visits among the control group (-2.3 and 8.3 percentage points respectively). For diarrhea treatment, more cases received ORT than antibiotics as one would expect given that antibiotics are only prescribed for dysentery. Use of ORT increased from 2005 to 2007, while use of antibiotics declined dramatically, though the numbers are small. This decline may in part be attributable to the seasonality of dysentery which is more prevalent during the rainy season, when 2005 data was collected, versus the dry season, when 2007 data was collected. For fever treatments, fever reducers were more commonly taken compared to anti-malarial medications. Use of anti-malarials in fact declined from 2005 to 2007 for both the intervention and control groups, which may be due to a lower prevalence of malaria in 2007.[100]

For each outcome a basic linear probability model (LPM) and an LPM with community fixed effects were estimated. Minimal differences were found between the model estimates with and without community fixed effects. The LPM with fixed effects provides a slightly more conservative estimate for the intervention and control groups, and is presented below. The difference-in-differences (DD) estimator is used to quantify the change in the intervention group relative to the control group. Lastly, the fixed effects models were run with and without "choice" variables (insurance, prior facility delivery) to identify any likely bias in estimates due to inclusion of these variables that may arguably introduce endogeneity to the model. No significant or substantial differences in program effect were found with or without these choice variables.

The full basic and fixed effects models with coefficients and standard errors are available in Appendix A.

Table 4.2. Number and percent of children reported ill, seeking care, and receiving treatment in past two weeks by study sample and year

	Intervention Group					Control Group				
	2005 [1]		2007 [2]		Absolute Change[3]	2005 [1]		2007 [2]		Absolute Change[3]
	N	%	N	%	%	N	%	N	%	%
Reported Illness										
Diarrhea	218	13.4	270	13.4	0.0	154	15.6	151	12.4	-3.2
Fever	437	26.8	426	21.2	-5.6*	247	25.1	276	22.7	-2.4
ARI	305	18.9	376	18.7	-0.2	177	18.2	212	17.5	-0.7
Facility consultation among those sick										
Diarrhea	35	16.4	87	32.5	16.1**	18	12.0	36	23.7	11.7*
Fever	108	24.8	146	35.7	10.9*	66	27.0	96	35.7	8.7
ARI	90	29.4	98	27.1	-2.3	47	27.0	70	35.3	8.3
Treatment among those who received facility consultation[4]										
For Diarrhea:										
ORT	22	61.9	56	64.4	2.5	11	61.8	26	73.0	11.2
Antibiotics	18	52.1	23	26.8	-25.3	9	49.9	11	29.9	-20.0
For Fever:										
Fever Reducer	46	42.4	73	50.5	8.1	29	46.6	43	45.4	-1.2
Anti-Malarial	22	20.4	16	11.3	-9.1	19	29.6	14	14.7	-14.9

Note: Denominators (not shown) change by study sample, year, and outcome.
[1] T-tests found no statistical difference between the intervention and control groups at baseline.
[2] T-tests found no statistical difference between the intervention and control groups post-intervention.
[3] T-tests for differences between 2005 and 2007; * $p<0.05$, ** $p<0.01$
[4] Insufficient numbers to calculate test statistic

The main regression results, including the difference-in-differences estimates, are presented in Tables 4.3-4.5. The change from 2005 to 2007 in the probability of illness among children living in intervention districts is in row one of Table 4.3; the change for the control population is in row two. A small, insignificant decline of 1.4 percentage points in reported diarrhea, fever, and/or ARI is reported for PBF districts. The decline is three times higher when only looking at diarrhea and/or fever, although the change is still not significant. The DD estimate suggests a larger reduction in reported disease in the PBF districts compared to the control districts, although the effect was small and insignificant. When adding in wealth interaction terms to examine the effect of PBF on equity of reported illness, no differences were found across wealth quintiles over time or between intervention and control groups (Appendix A.4, A.5).

Estimates for care seeking in Table 4.3 relied on the sample of reportedly ill children.[a] The regression results for care-seeking suggest improvements in both the intervention and control groups, yet we only find significant improvements in the control group, a 7.0 percentage point increase in care-seeking when sick with diarrhea, fever, and/or ARI and a 7.8 percentage point increase when only considering diarrhea and/or fever. There is no evidence that PBF had a significant effect on the probability of seeking care when ill (DD=-0.042, p=0.366; and DD=-0.030, p=0.540). Including wealth interaction terms revealed no significant differences in care-seeking behavior across wealth quintiles or intervention and control groups (Appendix A.4, A.5).

Table 4.3. Estimated change in the probability of reported childhood illness and facility care-seeking in PBF and Control Districts, from 2005 to 2007: DD regression results

	Reported Illness[1]		**Facility Care-Seeking**[2]	
	Diarrhea, Fever, ARI	Diarrhea, Fever	Diarrhea, Fever, ARI	Diarrhea, Fever
PBF District	-0.014	-0.042	0.028	0.048
	(0.027)	(0.023)	(0.031)	(0.033)
Control District	0.020	-0.020	0.070*	0.078*
	(0.034)	(0.032)	(0.033)	(0.035)
Average effect of PBF (DD estimate)	-0.034 (0.041)	-0.021 (0.037)	-0.042 (0.046)	-0.030 (0.049)
Number of Clusters	150	150	150	150
Number of Children	5,577	5,577	2,020	1,714

Robust standard errors in parentheses; statistical significance: *p<0.05, ** p<0.01
[1] LPM with fixed effects, covariates include: child's age, birth order, gender, and facility birth; mother's age, education, marital status; household wealth, toilet facilities, drinking water source, and bednet ownership.
[2] LPM with fixed effects, covariates include: child's age, birth order, gender, and facility birth; mother's age, education, marital status; household wealth, insurance status, and previous child death.

Data on medical treatments received is only available for those who reported an episode of diarrhea and/or fever in the prior two weeks. To estimate the impact of PBF on receipt of treatment, we further limit the sample to those children who reported seeking care at a health facility for the illness. The probability of receiving ORT, antibiotics, fever reducer, or anti-malarials was 14.5 percentage points higher among children living in PBF districts in 2007 compared to 2005 (p=0.014) (Table 4.4). While the probability of treatment among children living in control districts decreased 11.8 percentage points during the same time, although this finding was not significant (p=0.123). The average PBF program effect on receipt of treatment was 0.263 (p=0.005), indicating a strong program effect on the quality of services provided in PBF districts. For this outcome, the basic LPM without fixed effects produces smaller effects, smaller standard errors, and a smaller overall DD estimate. This is a departure from the pattern established for the illness and care-seeking where the estimates were close in size and typically a slight over-estimation was found in the basic LPM. One possible explanation is that the quality of services may be more strongly influenced by the rural location, which is differenced out of the fixed effects estimation. When a rural dummy variable is included in the basic LPM, the probability of treatment among rural residents is 7.1 percentage points higher (Appendix A.6).

Table 4.4. Estimated change in the probability of treatment received among children seeking curative care in PBF and Control Districts, from 2005 to 2007: DD regression results

	Basic LPM Model[1]	**LPM with Fixed Effects**[2]
PBF District	0.093	0.145*
	(0.053)	(0.058)
Control District	-0.062	-0.118
	(0.065)	(0.076)
Average effect of PBF	0.155	0.263**
(DD estimate)	(0.082)	(0.093)
Number of Clusters	150	150
Number of Children	499	499

Robust standard errors in parentheses; statistical significance: *p<0.05, ** p<0.01
[1] Covariates include: child's age, birth order, gender, and facility birth; mother's age, education, marital status; household wealth, insurance status, previous child death, and rural residence.
[2] Covariates include: child's age, birth order, gender, and facility birth; mother's age, education, marital status; household wealth, insurance status, and previous child death.

The impact on equity of child services is most apparent when studying the effect on treatment received in PBF districts. Table 4.5 presents the change in probability of treatment received over time for children living in PBF districts (row 1) and control districts (row 2), followed by the average effect of PBF on treatment received within each wealth quintile (DD estimate). The probability of receiving medication in 2007 was significantly higher for children from the three poorest quintiles living in PBF districts compared to children with similar wealth status living in control districts; 59.5, 64.6 and 44.1 percentage points higher for the poorest, poorer, and middle wealth groups respectively ($p<0.05$). Differencing yet again, we estimate the effects of PBF among children from the poorest 20% of households led to a 42.6 percentage point higher probability of receiving medicine compared to children from the least poor households in PBF districts and relative to the effect of PBF on the poorest compared to the least poor in control districts. While not statistically significant, the large, positive effect seen among the poorer 60% of the children suggests that PBF is pro-poor.

Table 4.5. Estimated change in the probability of treatment received for diarrhea or fever by wealth quintile, in PBF and Control Districts, from 2005 to 2007: DD and DDD regression results[1]

	Poorest	**Poorer**	**Middle**	**Less Poor**	**Least Poor**
PBF District	0.207 (0.181)	0.289 (0.180)	0.120 (0.114)	0.062 (0.132)	0.116 (0.129)
Control District	-0.388 (0.206)	-0.357* (0.170)	-0.311* (0.143)	0.003 (0.161)	-0.052 (0.134)
Average effect of PBF (DD estimate)	0.595* (0.272)	0.646* (0.248)	0.441* (0.179)	0.059 (0.206)	0.168 (0.178)
Average effect of PBF by wealth (DDD estimate)	0.426 (0.328)	0.478 (0.307)	0.272 (0.246)	-0.109 (0.306)	Ref.
Number of Clusters: 131					
Number of Children: 499					

Robust standard errors in parentheses; statistical significance: $*p<0.05$, $**\ p<0.01$
DDD estimate for poorest: (0.207- 0.388) – (0.166 - 0.052) = 0.426
[1]LPM with fixed effects, covariates include: child's age, birth order, gender, and facility birth; mother's age, education, marital status; household wealth, insurance status, and previous child death.

Discussion and Limitations

The premise upon which PBF is built is that increased health care worker productivity and quality of primary maternal and child health services provided will reduce the morbidity and mortality among vulnerable populations. In our analysis, we found no evidence to support the hypothesis that children living in PBF districts had a lower probability of reported diarrhea, fever, or symptoms of ARI. Moreover there was no finding of differential effect by wealth on morbidity; that is PBF was neither a pro-poor nor pro-rich strategy for reducing childhood illness. In fact, there was no measurable PBF effect on probability of illness in poorer households, as indicated by the coefficients for the wealth quintiles in the simple fixed effects specification without any wealth interactions (Appendix A.4, A.5). This is in line with findings from Schellenberg and colleagues, where no association between economic status and childhood morbidity was found in a population-based household survey in Tanzania.[35]

There are several possible explanations for our findings. First the window of time between initial program payments in June 2006 and the follow-up survey in December 2007 may arguably be too short to observe a cumulative impact on childhood health of better prenatal care, safer deliveries, and improved growth monitoring. Second, the decline in disease prevalence was a national trend with likely multiple contributors. For example, malaria decreased dramatically following a national insecticide-treated bednet campaign in September-October 2006. The prevalence of malaria in Rwanda in 2007 was half that of the lowest point reported in 2005.[100] The seasonality of data collection in 2005 compared to 2007 was also possibly correlated with seasonality of disease, particularly for severe diarrhea and malaria. Third, these acute childhood illnesses, particularly diarrhea and pneumonia, are the result of environmental exposures such as water and air quality or crowding. PBF is not designed to change the home environment, hence not addressing the causes of these diseases; rather the focus of PBF is on care-seeking and treatment.

The theoretical argument for improved outcomes in PBF program areas is easier to make for the direct health outputs rather than morbidity outcomes. In this case, looking at whether the incentive for outpatient curative care visits increased facility care-seeking for sick children, and whether the quality incentives for curative consultations improved the treatment received. Curative care consultations are incentivized through PBF at 0.18(USD) per visit, while receipt of medications is incentivized through the quarterly quality assessment conducted for each PBF facility. This assessment includes direct observation of 5 primary care consultations for children less than 5 years of age. Points are awarded based on appropriate treatment per national protocol.[101] Outpatient consultations are one of the least incentivized services yet the quality score is more influenced by treatment of children than by any other single item assessed. Perhaps this design of the incentive is in recognition of the limited role played by providers in outreach for these clients but their critical role in treatment once they seek care.

No PBF program effect was found for facility care-seeking either among those with diarrhea, fever and/or ARI, or just diarrhea and/or fever. Rather, the control populations sought facility care at a higher rate in 2007 compared to 2005. Living in a household with someone who has health insurance and being born in a health facility were associated with a higher probability of seeking facility care, which may be indicative of an underlying propensity to use the health system (Appendix A.4, A.5). One could argue that these choice variables may be the cause of potential endogeneity, [102] however when the models were run without these choice variables, no difference in outcome was found.

An alternate interpretation might be that the dramatic increase in health insurance in Rwanda increased economic access to services such as curative consultations and facility deliveries. Mutuelles de Santé were developed in an effort to mobilize resources locally for health centers and to reduce the financial barriers and risks families faced with unexpected medical costs. By 2007, an estimated 68% of households had at least one member covered by health insurance, 96% of these participated in a mutuelle.[14] In a 2011 study by Saksena and colleagues, the rate of curative consultations was 3-fold higher among those with health insurance compared to those without health insurance.[103] Moreover, they report that poorer households were less likely to have health insurance compared to the wealthiest households.[103] On a smaller scale, Dhillon and colleagues found a similar increase in patient visits once subsidies for mutuelles increased insurance coverage to near 100% in a rural community in Rwanda.[96] Interactions between insurance and PBF and insurance and wealth quintiles were tested but dropped due to insignificance. Disentangling the effects of PBF from the rise of mutuelles is difficult but a promising area for future study.

Children living in PBF districts were significantly and substantially more likely to receive medications and/or ORT when ill compared to children living in control districts. This finding reinforces the notion put forward by Basinga and colleagues that those services that are within the control of the provider and less reliant on repeated initiation by the consumer, are more likely to improve under PBF.[61] Huntington and colleagues also found an increase in medications received by sick children in pay-for-performance intervention sites in Egypt.[56] Granted not all cases of diarrhea or fever require a medical intervention, however Boerma and colleagues found in a multi-country study that the treatment of sick children was the most underutilized service, measured as a 58.8 percentage point gap between the potential maximum treatment received and a country's mean treatment received for the total population of sick children.[41] Globally, universal coverage of oral rehydration therapy could prevent an estimated 15% of deaths under age 5, while antimalarials and treatment of pneumonia could prevent an additional 5% each.[16] Given the exceptionally low usage for antimalarials in Rwanda, 5.6% among children under five years, and the reported 39% ORT use, clearly improvements are needed.[14] This study finding strongly indicates that the quality of childhood treatment improved significantly under PBF, despite the crudeness of the measure.

The potential contamination of study findings by other interventions or health system changes is a challenge for impact evaluations, even with a randomized study design. The difference-in-differences estimation strategy allows one to treat each community as its own control and the randomized intervention assignment creates a counterfactual for comparison. But the strategy cannot control for an unobserved intervention or shock to the health system or community that affects only select communities during the period between the pre- and post-measurement. For example, if the President's Malaria Initiative significantly increased the distribution of Artemisinin-based combination therapies (ACTs) for the treatment of malaria in select PBF districts in 2006 and not control districts, then absent information specific to ACT distribution, one is unable to control for that difference, hence biasing results in favor of PBF. The piloting of the Integrated Management of Childhood Illness (IMCI) in October 2006 is another example of potential bias. IMCI was piloted in three PBF districts, one control district, and three pilot PBF districts that were not included in this study. It is unclear whether the IMCI pilot had any effect on our findings. The pilot evaluation reports that on average only one provider per site was trained in IMCI and insufficient results are blamed on competition with PBF. Essentially the diagnostic and treatment algorithms for PBF are incentivized while those for IMCI are not specifically incentivized, such that providers may have been more inclined to follow PBF protocols rather than the piloted IMCI protocols vis-à-vis diagnosing and treatment offered.

The challenges of using a randomized study design for a national program evaluation are clear. Despite random assignment at baseline, it is virtually impossible to control for changes in the health system, either positive or negative, that affect some and not all sites uniformly. Yet the cost savings realized when using routinely collected national population-based survey data makes the trade-off an attractive alternative, especially in resource constrained settings.

Chapter 5

Conclusions and Implications

The overall objective of this dissertation was to determine the impact of PBF on equitable service utilization to meet the preventive and curative health care needs of women and children in Rwanda. PBF is built on the premise that increased productivity and quality of primary maternal and child health services will improve the health of the population. Rwanda's PBF program was designed to increase the quantity of facility-based health services and to improve the quality of those services. Given the prevailing low use of services across all segments of the population in Rwanda, particularly for facility deliveries, contraceptive use, and curative care consultations, PBF was adopted to improve universal access without specific provisions to target the poorest families. As in most low and middle income countries, the poorest in the population typically use fewer formal health services. Understanding the impact of a non-targeted health system financing program on the poorer households will help Rwanda, and other countries following its lead, ensure that the poorest and most vulnerable women and children are reached.

In brief, these analyses found that the PBF program positively increased the probability of health service use for the most highly incentivized service, facility deliveries. PBF was neither a pro-poor nor pro-rich strategy for increasing use of maternal or child health services studied. Moreover, no differential effect of PBF for woman's health care was found in urban versus rural communities. Regarding the quality of services, PBF was found to improve the probability of receiving medications among children whose caregivers sought a curative consultation for diarrhea and/or fever, and the data suggests improved benefits for the poorest children, although the findings are inconclusive. Following are suggested implications and methodological considerations from these two studies.

Policy Implications

Maternal and child health service use increased in both intervention and control groups from 2005 to 2007 for all services studied. In just over two years, use of the four studied maternal services increased by 13-17 percentage points in the control districts and 8-26 percentage points in the PBF districts. Moreover, these improvements were realized across all wealth groups, with some narrowing of the equity gap. Similar trends in service use were found for child consultations: curative care visits among those with reported childhood illnesses increased across the board for children living in intervention and control districts, and for children from most wealth quintiles. The improvement was more pronounced in control districts, where a 7.8 percentage point improvement in care-seeking for diarrhea and/or fever was found. However, the inequity in care-seeking remained constant over time for the intervention and control districts.

These improvements in service use were in fact a continuation of a national trend started in 2000.[2] The average effect of PBF, while substantial for facility deliveries, is negligible for other services given the increases seen overall. Three national strategies likely underlie these improvements: i) an increase in national health financing; ii) decentralization of the health system; and iii) a national increase in Mutuelle de Santé participation, or health insurance.

Health expenditures in Rwanda increased substantially from 73 million USD in 2000 to 301.6 million USD in 2006.[58] In conjunction with this increase in funding, the authority and decision-making vis-à-vis the use of funds were largely handed over to district-level health authorities in the nationwide decentralization process. In 2006, 30 new administrative districts were created. The new administrative authorities were responsible for and had authority over health, education, and economic development activities in their districts. These new district borders were drawn to include at least one hospital and to follow facility catchment boundaries as closely as possible. The increase in health expenditures and local autonomy benefited the scale-up of PBF, although the benefits were not exclusive to intervention districts. An equivalent amount of supplemental funding was provided to control districts during PBF scale-up, without any obligation to PBF. The impact of these gross funding increases should not be discounted.

Universal insurance coverage, most prominently accounted for by mutuelle participation, has been strongly encouraged by the government. In 2006, the government began subsidizing insurance premiums for the poorest 25% of households and by 2008 established, although did not enforce, a national policy that required participation in some type of insurance plan. By 2008, an estimated 85% of households in Rwanda had insurance.[104] A typical mutuelle plan covers basic services including family planning, ANC visits, curative consultations, facility deliveries, laboratory work, generic medicines and some hospitalizations. Mutuelles are designed to remove financial barriers to access and protect the insured against catastrophic health expenses. In Rwanda, studies have reported a positive effect of insurance on use of maternal and child health services.[95, 96, 103, 105] Saksena and colleagues, looking specifically at differential effects by wealth, found the impact of insurance on curative care use was higher among poorer households, suggesting that mutuelles may contribute to a narrowing of service inequity in Rwanda.[103]

In this dissertation analysis, a woman or child from a household with insurance had a higher probability of seeking ANC in the first trimester, delivering in a facility, and seeking curative care when sick. Yet no differential effect of PBF by insurance status was found for either maternal or child service use, nor when insurance was interacted with wealth. At baseline, there was no difference between the proportion of intervention and control households reporting some insurance coverage. At follow-up however, women and children living in intervention districts reported a significant increase in insurance participation, 25.8 and 13.2 percentage points respectively. Meanwhile for women living in control districts the increase in insurance was only 14.2 percentage points and for children, 4.1 percentage points. One interpretation of this differential increase is that insurance enrollment was promoted more in PBF districts. Health facilities, recognizing the high financial cost to families for facility care, may have facilitated insurance enrollment to eliminate one barrier to delivering in a facility. However, running the models with and without the insurance covariate did not change the results, suggesting that the effect of PBF was not mediated by insurance uptake. The synergistic effects of PBF and health insurance, particularly by wealth group, remain unclear. Further analysis, stratified by wealth group, may help disentangle the effects of supply-side incentives and removal of demand-side barriers.

Despite overall improvements in several of the service use outcomes studied, absence of measurable differences between intervention and control districts suggests a supply-side incentive is not adequate on its own to increase use, unless the incentive is large. For ANC care, contraceptive use, and curative care consults, the smaller incentives do not compel providers or facilities to reach out to the community. Offering a small incentive at minimum may protect against focusing all efforts on the most highly incentivized preventive services, although it would be useful to expand analysis to include non-incentivized services as well to provide a better picture of the potential effect. What's likely is that care-seeking for both preventive and curative care continues to rely on consumer's perception and ability to access care. A demand-side incentive or improvement in physical access (e.g., community health workers) or financial access (e.g., insurance) may have a stronger effect on seeking services at health facilities. PBF may indeed have led to creative demand-side promotions, particularly for increased insurance participation and use of community outreach. Following the national scale-up, additions to the PBF program have been suggested and implemented, including a formal incentive for community-based health workers who provide referrals and/or home services that fall under the umbrella of primary maternal and child care. Understanding how this expansion influences care in the framework of service provision in Rwanda will be a valuable addition to the body of literature regarding PBF.

Findings regarding quality incentives in PBF provide a different narrative. Among those who reported facility care-seeking for diarrhea and/or fever, the probability of receiving medication or ORT improved by 14.5 percentage points from 2005 to 2007 for those living in PBF districts; a stark contrast to the decrease in treatment received by those living in control districts. This improvement resulted in a 26.3 percentage point average increase in treatment received among those living in PBF districts relative to those living in control districts. Furthermore, the data strongly suggest that the poorest in PBF districts benefitted more by the program relative to the least poor in PBF districts and those living in control districts. Sick children from the three poorest quintiles in control districts actually suffered a 31-39 percentage point decline in medications and ORT received, while children from all wealth quintiles in PBF districts showed an increase in medications and ORT received. The study sample does not provide adequate power to observe statistically significant effects of PBF by wealth, although the large estimates for the poorest two quintiles indicate improvements in treatment received of over 40 percentage points compared to the least poor in the PBF districts and relative to the children in control districts. This data suggests that PBF positively influenced the treatment received during curative care visits and protected the services from the declines suffered by facilities in control districts. Reasons for the decline in control district services is unclear, although further investigation into possible disruptions in supply of medicine or a shift in focus away from child care services may be revealing. In intervention districts, the monthly quality assessments included a review of the pharmacy, which provided motivation to maintain an adequate supply of medicines and products.

These findings about medical treatment rely on indicators that serve as crude measures of need and quality. One could argue that not all reported cases of diarrhea and fever need medical intervention and if the incidence of malaria or dysentery has decreased since 2005, then the appropriate treatment may not be anti-malarials or antibiotics. Bryce and colleagues, however, propose that certain thresholds of care and care-seeking need to be met at a population level in order to reduce mortality.[17] For diarrhea, appropriate management with ORT should exceed 50% while appropriate treatment for fever should exceed 60%. Among the 2007 study population, only 38% received ORT among all those sick with diarrhea, yet 71% who sought facility care for diarrhea received ORT. Bearing in mind potential selection bias due to sicker children seeking care, this almost doubling of the proportion of sick children who received ORT when visiting the health facility suggests that better treatment is provided when cases are evaluated by a health professional. Among those with fever in 2007, less than 5% of reported cases were treated with anti-malarials while among those who sought facility care, 13% received anti-malarials, still far below the recommended 60% but an improvement. Some of this discrepancy between recommended and actual uptake may be accounted for by improved diagnostics that identified fewer malaria cases, although even if malaria incidence has declined and testing has increased, a 13% malaria treatment rate is low in a country where malaria remains one of the leading causes of childhood mortality. The bottom line is that too few sick children in Rwanda are receiving the appropriate management for diarrhea and fever. PBF is a promising practice for improving disease management at health facilities; however it hinges on increasing facility consultations.

In the context of Rwanda, these evaluation findings support the hypothesis that incentivizing quality of care improves the quality provided. Once a child needing care seeks consultation at a facility, then the care provided is an improvement over what would be received otherwise. The incentive structure rewards the critical role providers play in assuring the quality of services provided.

Programmatic Implications

Looking beyond the Rwanda experience, the findings from this study should encourage other countries exploring or implementing PBF programs to consider the extent of inequity in service use. If the level of service output and use is low across the board, then PBF may prove to be a valuable tool to address the inadequacy of quantity and quality of care. It is important however to design a PBF program with full recognition of the relative strengths and weaknesses of the system. First, health care providers will have the most influence on the quality of care and treatment provided once someone seeks curative or preventive care at a facility. Hence, prescribing the correct treatment or providing all immunizations and contraceptive choices to women and children is within the purview of the facility. Incentivizing the quality of supplies and services should be a part of any supply-side PBF scheme.

Recruiting women and children into care is more difficult to do without addressing demand-side constraints. Consumer inputs designed to reduce financial barriers, such as insurance, or to increase demand through outreach and education by community health worker (CHW) programs, are necessary companion strategies to supply-side efforts. While evidence supports the use of CHWs to increase childhood immunizations, reduce childhood morbidity and mortality from routine illness, and increase maternal care provided for ANC and family planning;[106, 107] no rigorous evaluation of incentivizing CHWs has been published. In a PBF scheme, CHWs could be incentivized to educate and refer the population to available primary maternal and child health care services. Alternately, CHWs may be trained to provide some doorstep services for those families where travel prohibits or discourages facility care. These services can cover basic ANC counseling, family planning education and resupply of contraceptives, or rapid testing and in-home treatment of childhood illnesses such as diarrhea, fever or ARI. Implementing a network of CHWs requires comprehensive training in patient education, appropriate in-home services, and recognizing signs and symptoms for referral care. Moreover, controls need to be put in place to monitor the quality of this off-site work as well as the validity of reporting. An evaluation of Rwanda's experience with expanding PBF to CHWs would be a welcome addition to the evidence base for PBF.

If a large gap exists between the poorest and least poor populations, then a uniform supply-side financing program described above will do little to close that gap, rather a targeted approach is needed. Two targeting methods deserve consideration depending on the country context. First a geographic approach has been successful in countries where underserved populations are identifiable based on location, such as rural remote communities or poor, urban slums.[54, 108] The PBF incentive structure can be designed to favor service provision in these poorer communities through higher incentives per service or combined with consumer vouchers to encourage use.

A second promising method is the setting of performance targets specific to poorer families, such as the case in Cambodia which rewarded providers for documented improvement in immunization rates among the poorer half of the population.[109] Setting differential performance targets would oblige health facilities to identify and track clients by wealth status, establish outreach efforts to recruit clients from poorer households, and reduce consumer barriers for these poorest families. Ideally these efforts would build on existing programs that target the underserved. For example in Rwanda the government subsidizes insurance premiums for the poorest 25% of the population. This effort requires identification of the target population and tracking to assure appropriate receipt of the benefit. An equity performance target could build on this project by incentivizing services provided to this population with subsidized insurance. Similarly, another program gaining traction in some countries is the issuance of identification cards for poor households, a government initiative to determine which households are poor and identify their level of poverty. This information could be made available to agencies such as health facilities, in order to target services directly to these households. Subsequently when services are used it allows for the tracking of care provided. This approach would motivate providers to serve the poorer households, but may still require outreach and consumer incentives to motivate the poor to seek services.

Methodological Issues

There are some methodological issues from this evaluation that merit discussion. National program evaluations are challenging due to the uncontrolled and oftentimes unpredictable influences of factors external to the intervention and the evaluation. For example, environmental factors such as topographical variations that impede access to facilities in Rwanda or produce different environmental risk factors for illness due to water quality or population density may have an unmeasured effect on program implementation and uptake. Confounding may also be introduced due to new program efforts launched during the period under evaluation. Lastly, rapid economic growth and improvements in health nationally may make it hard to identify progress attributable to one specific program. Without appropriate measurement and control for these changes, confounding may bias evaluation findings.[110]

Fortunately the scale-up of PBF in Rwanda followed a stepped-wedge design,[111] wherein PBF was introduced in a phased approach with random assignment to early and late implementation phases. Matching districts on rainfall, density, and livelihood, prior to random PBF assignment provided an opportunity to control for the environmental and socio-economic characteristics of these communities that might influence health outcomes. Econometric techniques were employed to control for potential additional unobserved time-invariant confounders such as community infrastructure or educational opportunities. Potential bias remains, however, if unmeasured shocks to the health system occurred for some and not all study districts, particularly if an intervention was targeted to build on the new PBF system. For example, if the President's Malaria Initiative substantially increased the availability of ACTs for the treatment of malaria in intervention districts only, perhaps due to a perception by donors of better pharmaceutical supply chains in these districts, then results may be biased. If on the other hand, the facilities in PBF districts were better positioned to maximize the use of the increased availability of anti-malarials, then the improvements in malaria treatment due to PBF may be overstated, suggesting a stronger effect of PBF than warranted. While these scenarios may confound program effects, the alternative of withholding all other interventions or improvements over the duration of a study is impractical and unethical given the multiple health challenges faced in developing countries. Researchers instead need to maximize opportunities for evaluation, such as was done with the stepped-wedge design, and collect or use available data that improves the ability to control for confounders as much as possible.

The second consideration is the data sources used for national program evaluations. Oftentimes, evaluations of facility interventions rely on service use data from health information systems or population-based survey data collected specifically for evaluation of the program in question. There are advantages and limitations to both: measurement of program inputs per facility and outputs per individual tied to a specific facility are possible with routine systems and surveys, yet incentivized reporting may confound program outputs and surveys are expensive. Using existing national data has advantages and limitations as well. In the case of Rwanda, two DHS studies book-ending the implementation period for initial program roll-out, with the same clusters sampled, provided a unique opportunity to look at data longitudinally. The random assignment at the district level, allowed for aggregating data across intervention and control districts, thereby reducing concern that district-specific data alone was not adequate to draw population-level conclusions. Most importantly, in a country facing competing financial priorities, using existing DHS data for evaluation purposes is cost-effective and maximizes the resource input that Rwanda already made to gather and produce nationally representative datasets. The primary limitation is the inability to link the study population to the specific facility used for health care received, as specific facility data is not collected in the RDHS. Instead the study populations and health facilities were assigned intervention and control status based on their location within an administrative district. The two primary assumptions are that individuals use facilities within their residential district and all facilities within a district converted successfully to PBF. Future work assessing the potential measurement error introduced due to varying methods of linking communities to facilities may shed light on better techniques to improve the community-facility links.

Conclusion

Rwanda has produced remarkable results from their efforts to improve maternal and child health service utilization over the past several years, including progress in reducing the equity gap. Studying these efforts provides some insights into what works and doesn't work in Rwanda and what may be successfully replicated elsewhere. Countries across sub-Saharan Africa are implementing new PBF-style financing strategies in an effort to improve health services. Understanding the provider's role and scope of influence vis-à-vis access and quality will inform policy makers in how best to advocate for and implement change. Implications from this research suggest that demand-side and supply-side incentives are needed to increase use of services and improve the quality of those services. Moreover, if service use is uniformly low then a PBF program that has standard performance targets, particularly for services that are well reimbursed, such as facility deliveries, may improve service use overall. However if the equity gap is extreme or service use is sub-optimal among the poorer populations, then a non-targeted PBF program like Rwanda's will likely do little to alleviate disparities. Complementary efforts that address demand-side barriers, such as health insurance, waived fees, or voucher schemes, may result in an accelerated improvement among the poorest.

Appendix A

Tables

Table A.1. Output indicators and quality weights used to determine performance-based financing payments

Output Indicators – payment per unit	Payment	Quality of Services	Weight
Visit and Outreach Indicators	(USD)	General Administration	0.052
Curative care visits	0.18	Cleanliness	0.028
1st prenatal care visits	0.09	Curative care	0.170
4 completed ANC visits	0.37	Delivery	0.130
1st time family planning visits (new users)	1.83	Prenatal Care	0.126
One-month contraceptive resupply	0.18	Family Planning	0.114
Facility delivery	4.59	Immunizations	0.070
Child (0-59 months) growth monitoring visits	0.18	Growth Monitoring	0.520
Completed childhood vaccines on time	0.92	HIV Services	0.090
Content of Care Indicators		TB Services	0.028
Appropriate tetanus vaccine during ANC	0.46	Lab Services	0.030
2nd does of malaria prophylaxis during ANC	0.46	Pharmacy Management	0.060
At-risk pregnancies referred to hospital for delivery	1.83	Financial Management	0.050
Emergency transfers to hospitals for obstetric care	4.59		
Malnourished children referred for treatment	1.83		
Other emergency referrals during curative treatment	1.83		

Table A.2. Linear probability models for effect of PBF on maternal health service use, with and without community fixed effects

	Early ANC Initiation		4 or More ANC Visits		Facility Delivery		Modern Contraception	
	DD Model	**DD with FE**	**DD Model**	**DD with FE**	**DD Model**	**DD with FE**	**DD Model**	**DD with FE**
	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)
Year 2007	0.144***	0.140***	0.140***	0.136***	0.170***	0.169***	0.148***	0.148***
	(0.027)	(0.027)	(0.027)	(0.026)	(0.033)	(0.033)	(0.017)	(0.017)
PBF District	0.015		0.042		-0.040		0.001	
	(0.019)		(0.025)		(0.028)		(0.013)	
2007 * PBF District	0.004	0.011	-0.052	-0.053	0.090*	0.100*	0.009	0.010
	(0.036)	(0.037)	(0.036)	(0.036)	(0.039)	(0.040)	(0.022)	(0.022)
Wealth (Ref: Least Poor)								
Poorest	-0.016	0.006	-0.055	-0.035	-0.120***	-0.091*	-0.069**	-0.060*
	(0.028)	(0.028)	(0.032)	(0.032)	(0.033)	(0.036)	(0.021)	(0.023)
Poorer	-0.012	-0.008	-0.027	-0.030	-0.090**	-0.073*	-0.081***	-0.073***
	(0.029)	(0.030)	(0.033)	(0.033)	(0.034)	(0.036)	(0.020)	(0.022)
Middle	-0.023	-0.013	-0.044	-0.029	-0.060	-0.041	-0.074***	-0.068***
	(0.028)	(0.028)	(0.030)	(0.031)	(0.031)	(0.032)	(0.019)	(0.019)
Less Poor	-0.017	-0.011	-0.022	-0.017	-0.075*	-0.072*	-0.041*	-0.037
	(0.028)	(0.029)	(0.033)	(0.033)	(0.031)	(0.032)	(0.020)	(0.021)
Rural Residence	-0.049		-0.005		-0.052		-0.028	
	(0.030)		(0.029)		(0.032)		(0.027)	
Age	-0.001	-0.001	0.001	0.000	0.002	0.002	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Education (Ref: No School)								
Primary School	0.002	-0.005	0.010	-0.005	0.048*	0.042	0.033**	0.028*
	(0.020)	(0.021)	(0.019)	(0.020)	(0.022)	(0.022)	(0.012)	(0.012)
Secondary School	0.046	0.023	-0.016	-0.030	0.193***	0.169***	0.108***	0.098***

	(0.042)	(0.045)	(0.036)	(0.037)	(0.038)	(0.039)	(0.026)	(0.027)
Married	0.047*	0.059*	0.072**	0.079**	0.026	0.049		
	(0.021)	(0.024)	(0.024)	(0.026)	(0.027)	(0.029)		
Parity (Ref: ≥ 5 Births)								
1 Birth	0.085*	0.088*	0.077	0.072	0.426***	0.404***	0.131***	0.134***
	(0.035)	(0.036)	(0.039)	(0.040)	(0.039)	(0.041)	(0.017)	(0.018)
2-4 Births	0.026	0.029	0.028	0.028	0.053	0.046	0.255***	0.253***
	(0.021)	(0.022)	(0.027)	(0.028)	(0.027)	(0.028)	(0.019)	(0.021)
≥ 5 Births (Ref: No Births)							0.327***	0.328***
							(0.023)	(0.024)
Health Insurance	0.037*	0.038*	0.021	0.028	0.058**	0.055*	0.016	0.008
	(0.016)	(0.018)	(0.017)	(0.019)	(0.020)	(0.022)	(0.011)	(0.012)
Prior Facility Delivery	0.006	-0.003	0.065*	0.053	0.402***	0.367***	-0.055**	-0.053**
	(0.021)	(0.022)	(0.029)	(0.029)	(0.028)	(0.030)	(0.017)	(0.017)
Any ANC Visits					0.202***	0.192***		
					(0.030)	(0.035)		
Prior Child Death							-0.075***	-0.074***
							(0.014)	(0.014)
Constant	0.051	0.001	0.003	0.038	-0.102	-0.155	0.094*	0.069*
	(0.073)	(0.073)	(0.094)	(0.089)	(0.092)	(0.097)	(0.039)	(0.033)
Number of Clusters	150	150	150	150	150	150	150	150
Number of Women	1983	1983	1983	1983	1977	1977	4050	4050

* p<0.05, **p<0.01, *** p<0.001

Table A.3. Linear probability models with community fixed effects for effect of PBF on maternal health service use, differentiated by wealth and stratified by residence

	Early ANC Initiation			**Four or more ANC Visits**			**Facility Delivery**			**Modern Contraception**		
	Total Coeff (SE)	**Rural** Coeff (SE)	**Urban** Coeff (SE)	**Total** Coeff (SE)	**Rural** Coeff (SE)	**Urban** Coeff (SE)	**Total** Coeff (SE)	**Rural** Coeff (SE)	**Urban** Coeff (SE)	**Total** Coeff (SE)	**Rural** Coeff (SE)	**Urban** Coeff (SE)
Year 2007	0.148**	0.099	0.228*	0.212***	0.211**	0.213	0.107	0.159	0.016	0.169***	0.169**	0.227*
	(0.056)	(0.061)	(0.105)	(0.059)	(0.072)	(0.119)	(0.064)	(0.101)	(0.051)	(0.044)	(0.053)	(0.081)
2007 * PBF District	0.024	0.098	-0.030	-0.150	-0.135	-0.043	0.070	0.050	0.155	-0.033	-0.060	0.008
	(0.082)	(0.089)	(0.156)	(0.084)	(0.099)	(0.153)	(0.083)	(0.118)	(0.116)	(0.056)	(0.070)	(0.098)
2007 * PBF	-0.062	-0.147	0.012	0.091	0.087	-0.069	-0.040	-0.018	0.096	0.058	0.082	-0.031
* Poorest	(0.104)	(0.111)	(0.304)	(0.103)	(0.121)	(0.242)	(0.119)	(0.148)	(0.300)	(0.072)	(0.083)	(0.181)
2007 * PBF	-0.097	-0.178	0.014	0.048	0.080	-0.642	0.102	0.122	0.022	0.022	0.034	0.054
* Poorer	(0.113)	(0.122)	(0.327)	(0.122)	(0.138)	(0.327)	(0.114)	(0.143)	(0.337)	(0.072)	(0.084)	(0.196)
2007 * PBF	0.029	0.071	-0.573*	0.197	0.224	-0.277	0.045	0.081	-0.012	0.088	0.114	0.073
* Middle	(0.106)	(0.115)	(0.254)	(0.119)	(0.129)	(0.298)	(0.112)	(0.151)	(0.189)	(0.075)	(0.086)	(0.190)
2007 * PBF	0.051	-0.027	0.167	0.139	0.108	0.290	0.020	0.108	-0.379	0.056	0.089	0.009
* Less Poor	(0.117)	(0.129)	(0.212)	(0.112)	(0.124)	(0.259)	(0.123)	(0.152)	(0.231)	(0.073)	(0.088)	(0.146)
2007 * Poorest	0.044	0.107	0.075	-0.111	-0.084	-0.104	0.135	0.071	0.390*	-0.048	-0.046	-0.131
	(0.070)	(0.078)	(0.220)	(0.077)	(0.094)	(0.148)	(0.090)	(0.122)	(0.148)	(0.055)	(0.065)	(0.120)
2007 * Poorer	0.030	0.093	-0.143	-0.076	-0.086	0.000	0.009	-0.030	0.113	-0.006	0.012	-0.045
	(0.087)	(0.095)	(0.169)	(0.093)	(0.107)	(0.185)	(0.086)	(0.118)	(0.154)	(0.057)	(0.064)	(0.120)
2007 * Middle	-0.040	-0.055	0.124	-0.097	-0.100	0.000	0.142	0.093	0.245*	-0.058	-0.052	-0.159
	(0.074)	(0.083)	(0.158)	(0.090)	(0.095)	(0.222)	(0.092)	(0.132)	(0.093)	(0.059)	(0.066)	(0.148)
2007 * Less Poor	-0.062	0.009	-0.249	-0.102	-0.070	-0.258	0.035	-0.051	0.313	-0.010	-0.010	-0.061
	(0.087)	(0.097)	(0.135)	(0.086)	(0.094)	(0.201)	(0.091)	(0.119)	(0.170)	(0.055)	(0.066)	(0.085)
Wealth (Ref: Least Poor)												
Poorest	-0.017	-0.039	-0.059	-0.004	0.035	-0.180	-0.158*	-0.166*	-0.380*	-0.033	-0.019	-0.117
	(0.043)	(0.048)	(0.072)	(0.058)	(0.067)	(0.095)	(0.067)	(0.083)	(0.152)	(0.041)	(0.042)	(0.136)

Poorer	0.007	-0.034	0.121	-0.016	0.008	-0.090	-0.088	-0.090	-0.251	-0.068*	-0.056	-0.211**
	(0.051)	(0.055)	(0.112)	(0.062)	(0.073)	(0.104)	(0.066)	(0.083)	(0.136)	(0.033)	(0.035)	(0.065)
Middle	0.014	-0.008	0.006	0.037	0.062	-0.041	-0.119	-0.157	-0.126	-0.043	-0.039	-0.104
	(0.045)	(0.055)	(0.071)	(0.062)	(0.073)	(0.098)	(0.065)	(0.085)	(0.125)	(0.034)	(0.036)	(0.104)
Less Poor	0.035	0.005	0.076	0.021	0.051	-0.054	-0.069	-0.061	-0.243	-0.050	-0.022	-0.225***
	(0.053)	(0.062)	(0.105)	(0.064)	(0.071)	(0.144)	(0.061)	(0.075)	(0.137)	(0.038)	(0.039)	(0.057)
Age	-0.001			0.000			0.001			-0.006***		
	(0.002)			(0.002)			(0.002)			(0.001)		
Education (Ref: No School)												
Primary	-0.006			-0.004			0.039			0.027*		
	(0.021)			(0.020)			(0.022)			(0.013)		
Secondary	0.022			-0.029			0.168***			0.099***		
	(0.045)			(0.037)			(0.039)			(0.027)		
Married	0.059*	0.047	0.136	0.080**	0.077**	0.126	0.050					
	(0.024)	(0.027)	(0.071)	(0.026)	(0.029)	(0.083)	(0.029)					
Parity (Ref: ≥ 5 Births)												
1 Birth	0.086*	0.076**	0.110	0.070	0.042	0.036	0.408***	0.372***	0.450***	0.134***	0.120***	0.187*
	(0.037)	(0.026)	(0.065)	(0.040)	(0.026)	(0.069)	(0.041)	(0.028)	(0.062)	(0.018)	(0.017)	(0.072)
2-4 Births	0.028			0.026			0.046			0.254***	0.177***	0.286***
	(0.023)			(0.029)			(0.028)			(0.021)	(0.016)	(0.056)
≥ 5 Births (Ref: No Births)										0.329***	0.166***	0.253***
										(0.024)	(0.014)	(0.059)
Health Insurance	0.038*	0.027	0.036	0.029	0.035	-0.001	0.056*			0.008		
	(0.018)	(0.018)	(0.054)	(0.019)	(0.022)	(0.046)	(0.022)			(0.012)		
Prior Facility Birth	-0.002			0.052			0.368***	0.380***	0.457***	-0.053**		
	(0.022)			(0.029)			(0.029)	(0.031)	(0.074)	(0.017)		
Any ANC Visits							0.193***	0.197***	0.254*			
							(0.036)	(0.042)	(0.090)			

Prior Child Death										-0.075***		
										(0.014)		
Constant	-0.004	0.027	-0.126	0.024	0.049	-0.013	-0.114	0.065	0.092	0.068*	-0.037	-0.070
	(0.075)	(0.039)	(0.090)	(0.092)	(0.048)	(0.107)	(0.096)	(0.053)	(0.070)	(0.034)	(0.025)	(0.066)
Number of Clusters	150	128	22	150	128	22	150	128	22	150	128	22
Number of Women	1983	1733	302	1983	1733	302	1977	1682	296	4050	3586	535

* p<0.05, **p<0.01, *** p<0.001

Note: Coefficients for PBF*Poorest (Poorer, Middle, Less Poor) not included in table

Table A.4. Linear probability models for effect of PBF on reported diarrhea, fever and/or symptoms of ARI, and facility care-seeking, differentiated by wealth

	Reported Diarrhea, Fever, ARI			**Facility Care-Seeking**		
	DD Model	**DD with FE**	**DDD by Wealth, FE**	**DD Model**	**DD with FE**	**DDD by Wealth, FE**
	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)
Year 2007	0.023	0.020	0.068	0.078*	0.070*	0.193*
	(0.034)	(0.034)	(0.042)	(0.032)	(0.033)	(0.084)
PBF District	0.017			0.020		
	(0.031)			(0.031)		
2007 * PBF District	-0.033	-0.034	-0.102	-0.042	-0.042	-0.223*
	(0.041)	(0.041)	(0.063)	(0.045)	(0.046)	(0.107)
2007 * PBF * Poorest			0.054			0.203
			(0.084)			(0.142)
2007 * PBF * Poorer			0.110			0.194
			(0.094)			(0.141)
2007 * PBF * Middle			0.136			0.291*
			(0.082)			(0.147)
2007 * PBF *			0.046			0.198
Less Poor			(0.083)			(0.137)
2007 * Poorest			-0.079			-0.143
			(0.055)			(0.111)
2007 * Poorer			-0.068			-0.183
			(0.068)			(0.110)
2007 * Middle			-0.114			-0.208
			(0.060)			(0.115)
2007 * Less Poor			-0.004			-0.088
			(0.058)			(0.110)
Wealth (Ref.Group: Least Poor)						
Poorest	0.009	0.010	0.029	-0.150***	-0.144**	-0.147
	(0.028)	(0.028)	(0.047)	(0.041)	(0.046)	(0.078)
Poorer	0.038	0.038	0.030	-0.134***	-0.119**	-0.074
	(0.027)	(0.028)	(0.058)	(0.040)	(0.045)	(0.077)
Middle	0.049*	0.050*	0.102	-0.094**	-0.089*	-0.017
	(0.024)	(0.023)	(0.052)	(0.035)	(0.037)	(0.078)
Less Poor	0.042*	0.040	0.008	-0.092*	-0.084*	-0.096
	(0.021)	(0.021)	(0.034)	(0.037)	(0.038)	(0.080)
Rural Residence	0.003			0.091**		
	(0.024)			(0.032)		
Health Insurance				0.168***	0.145***	0.148***
				(0.022)	(0.024)	(0.024)
Child's Age (Ref: 0-11 months)						

12-23 months	0.082***	0.084***	0.084***	-0.017	-0.021	-0.021
	(0.020)	(0.020)	(0.019)	(0.026)	(0.027)	(0.026)
24-35 months	-0.045*	-0.043*	-0.043*	-0.024	-0.021	-0.020
	(0.020)	(0.020)	(0.020)	(0.032)	(0.033)	(0.033)
36-47 months	-0.084***	-0.081***	-0.081***	-0.067*	-0.075*	-0.076*
	(0.019)	(0.019)	(0.019)	(0.033)	(0.032)	(0.032)
48-59 months	-0.129***	-0.127***	-0.127***	-0.126***	-0.127***	-0.131***
	(0.021)	(0.021)	(0.021)	(0.035)	(0.036)	(0.036)
Birth Order (Ref: 5th or higher)						
First	-0.017	-0.017	-0.018	0.048	0.059	0.053
	(0.030)	(0.030)	(0.030)	(0.048)	(0.049)	(0.048)
Second-Fourth	-0.034	-0.034	-0.033	0.027	0.024	0.022
	(0.020)	(0.020)	(0.020)	(0.033)	(0.034)	(0.034)
Child's Sex: Boy	0.004	0.003	0.003	0.001	0.007	0.007
	(0.012)	(0.012)	(0.012)	(0.020)	(0.020)	(0.020)
Born in Health Facility	-0.009	-0.003	-0.002	0.113***	0.096***	0.098***
	(0.013)	(0.013)	(0.013)	(0.024)	(0.025)	(0.025)
Mother's Age	-0.003	-0.003	-0.003	0.001	0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mother's Education (Ref: No School)						
Primary School	-0.032	-0.030	-0.030	-0.007	-0.011	-0.012
	(0.017)	(0.017)	(0.017)	(0.025)	(0.026)	(0.027)
Secondary School	0.002	0.004	0.007	0.111*	0.125*	0.134*
	(0.033)	(0.034)	(0.034)	(0.051)	(0.054)	(0.055)
Mother Married	-0.041*	-0.043*	-0.043*	-0.063*	-0.064*	-0.063
	(0.020)	(0.021)	(0.021)	(0.029)	(0.032)	(0.032)
Improved Toilet Facility	0.010	0.008	0.015			
	(0.016)	(0.016)	(0.017)			
Clean Water Source	-0.014	-0.013	-0.014			
	(0.022)	(0.024)	(0.025)			
Slept under bednet	-0.002	0.002	0.001			
	(0.015)	(0.015)	(0.015)			
Previous Child Death				0.002	0.004	0.002
				(0.026)	(0.027)	(0.028)
Constant	0.521***	0.530***	0.520***	0.165	0.255*	0.242*
	(0.064)	(0.065)	(0.070)	(0.103)	(0.106)	(0.109)
Number of Clusters	150	150	150	150	150	150
Number of Children	5577	5577	5577	2020	2020	2020

* p<0.05, **p<0.01, *** p<0.001

Table A.5. Linear probability models for effect of PBF on reported on reported diarrhea and/or fever, and care-seeking, differentiated by wealth

	Ill with Diarrhea or Fever			Facility Care-Seeking		
	DD Model	**DD with FE**	**DDD with FE**	**DD Model**	**DD with FE**	**DDD with FE**
	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)
Year 2007	-0.018	-0.020	0.013	0.081*	0.078*	0.136
	(0.031)	(0.032)	(0.041)	(0.033)	(0.035)	(0.089)
PBF District	0.006			0.018		
	(0.029)			(0.033)		
2007 * PBF District	-0.021	-0.021	-0.081	-0.022	-0.030	-0.164
	(0.037)	(0.037)	(0.059)	(0.047)	(0.049)	(0.117)
2007 * PBF * Poorest			0.007			0.168
			(0.080)			(0.158)
2007 * PBF * Poorer			0.160			0.133
			(0.087)			(0.158)
2007 * PBF * Middle			0.088			0.228
			(0.080)			(0.164)
2007 * PBF * Less Poor			0.041			0.125
			(0.082)			(0.149)
2007 * Poorest			-0.029			-0.080
			(0.054)			(0.122)
2007 * Poorer			-0.103			-0.089
			(0.062)			(0.123)
2007 * Middle			-0.070			-0.148
			(0.059)			(0.123)
2007 * Less Poor			0.023			0.015
			(0.061)			(0.114)
Poorest	0.005	0.005	0.006	-0.123**	-0.117*	-0.187*
	(0.025)	(0.026)	(0.045)	(0.043)	(0.049)	(0.083)
Poorer	0.009	0.007	0.029	-0.105*	-0.087	-0.130
	(0.026)	(0.026)	(0.056)	(0.042)	(0.047)	(0.080)
Middle	0.042	0.041	0.078	-0.071*	-0.065	-0.041
	(0.023)	(0.023)	(0.051)	(0.035)	(0.038)	(0.080)
Less Poor	0.034	0.030	0.003	-0.074	-0.060	-0.143
	(0.021)	(0.021)	(0.038)	(0.038)	(0.039)	(0.079)
Rural Residence	0.010			0.092**		
	(0.024)			(0.034)		
Health Insurance				0.174***	0.144***	0.146***
				(0.024)	(0.026)	(0.026)
Child's Age (Ref: 0-11 months)						
12-23 months	0.083	0.086***	0.086***	-0.019	-0.015	-0.013
	(0.019)	(0.019)	(0.019)	(0.028)	(0.029)	(0.029)

24-35 months	-0.036	-0.034	-0.035	-0.004	0.008	0.008
	(0.019)	(0.019)	(0.019)	(0.033)	(0.034)	(0.034)
36-47 months	-0.083	-0.081***	-0.081***	-0.057	-0.063	-0.062
	(0.018)	(0.018)	(0.018)	(0.035)	(0.034)	(0.034)
48-59 months	-0.124	-0.122***	-0.123***	-0.116**	-0.102*	-0.103**
	(0.020)	(0.020)	(0.020)	(0.037)	(0.039)	(0.039)
Birth Order (Ref: 5th or higher)						
First	-0.025	-0.023	-0.021	0.049	0.055	0.044
	(0.026)	(0.026)	(0.026)	(0.050)	(0.052)	(0.051)
Second-Fourth	-0.028	-0.026	-0.025	0.025	0.019	0.015
	(0.018)	(0.018)	(0.018)	(0.036)	(0.037)	(0.037)
Child's Sex: Boy	0.014	0.013	0.012	-0.011	-0.005	-0.005
	(0.011)	(0.012)	(0.012)	(0.020)	(0.020)	(0.021)
Born in Health Facility	-0.005	0.001	0.002	0.110***	0.096***	0.094***
	(0.013)	(0.013)	(0.013)	(0.026)	(0.028)	(0.028)
Mother's Age	-0.002	-0.002	-0.002	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Mother's Education (Ref: No School)						
Primary School	-0.031	-0.029	-0.029	-0.004	-0.011	-0.010
	(0.017)	(0.017)	(0.017)	(0.025)	(0.028)	(0.028)
Secondary School	-0.056	-0.053	-0.052	0.151**	0.161**	0.174**
	(0.031)	(0.032)	(0.032)	(0.054)	(0.058)	(0.057)
Mother Married	-0.037	-0.040*	-0.040*	-0.063*	-0.055	-0.057
	(0.018)	(0.018)	(0.018)	(0.032)	(0.035)	(0.036)
Improved Toilet	0.004	0.003	0.008			
	(0.016)	-0.016	-0.017			
Clean Water Source	-0.013	(0.013)	(0.015)			
	(0.020)	-0.022	-0.022			
Slept under bednet	0.009	0.011	0.011			
	(0.013)	(0.014)	(0.014)			
Previous Child Death				0.012	0.014	0.010
				(0.029)	(0.031)	(0.031)
Constant	0.442***	0.447***	0.442***	0.145	0.237*	0.251*
	(0.061)	(0.061)	(0.066)	(0.110)	(0.112)	(0.114)
Number of Clusters	150	150	150	150	150	150
Number of Children	5577	5577	5577	1714	1714	1714

* p<0.05, **p<0.01, *** p<0.001

Table A.6. Linear probability models for effect of PBF on treatment received for diarrhea and/or fever among those seeking facility care, differentiated by wealth

	Treatment Received		
	DD Model	**DD with FE**	**DDD with FE**
	Coeff (SE)	Coeff (SE)	Coeff (SE)
Year 2007	-0.062	-0.118	-0.052
	(0.065)	(0.076)	(0.134)
PBF District	-0.093		
	(0.067)		
2007 * PBF District	0.155	0.263**	0.168
	(0.082)	(0.093)	(0.178)
2007 * PBF * Poorest			0.427
			(0.328)
2007 * PBF * Poorer			0.478
			(0.307)
2007 * PBF * Middle			0.272
			(0.246)
2007 * PBF * Less Poor			-0.109
			(0.306)
2007 * Poorest			-0.336
			(0.236)
2007 * Poorer			-0.305
			(0.209)
2007 * Middle			-0.259
			(0.167)
2007 * Less Poor			0.055
			(0.246)
Poorest	-0.099	-0.116	0.382
	(0.068)	(0.075)	(0.216)
Poorer	-0.136	-0.207*	-0.028
	(0.070)	(0.082)	(0.158)
Middle	-0.017	-0.038	0.093
	(0.058)	(0.059)	(0.145)
Less Poor	-0.059	-0.108	-0.013
	(0.059)	(0.063)	(0.191)
Rural Residence	0.071		
	(0.072)		
Health Insurance	-0.053	-0.078	-0.083
	(0.050)	(0.057)	(0.057)
Child's Age			
12-23 months	-0.002	-0.028	-0.026
	(0.051)	(0.058)	(0.059)

24-35 months	0.013	-0.011	-0.021
	(0.062)	(0.066)	(0.067)
36-47 months	-0.035	-0.068	-0.067
	(0.066)	(0.069)	(0.066)
48-59 months	-0.151	-0.142	-0.134
	(0.094)	(0.100)	(0.097)
Birth Order (Ref: 5th or higher)			
First	0.234*	0.238*	0.249*
	(0.096)	(0.112)	(0.116)
Second-Fourth	0.202**	0.208**	0.216**
	(0.063)	(0.073)	(0.075)
Child's Sex: Boy	0.014	0.041	0.043
	(0.045)	(0.050)	(0.051)
Born in Health Facility	0.037	-0.016	-0.014
	(0.047)	(0.052)	(0.053)
Mother's Age	0.012**	0.012*	0.012*
	(0.004)	(0.005)	(0.005)
Mother's Education			
Primary School	0.021	0.013	0.004
	(0.057)	(0.064)	(0.066)
Secondary School	0.019	0.042	0.044
	(0.091)	(0.106)	(0.108)
Mother Married	0.069	0.082	0.085
	(0.066)	(0.070)	(0.069)
Previous Child Death	0.151**	0.149**	0.148*
	(0.049)	(0.055)	(0.059)
Constant	0.103	0.171	0.140
	(0.208)	(0.220)	(0.231)
Number of Clusters	131	131	131
Number of Children	499	499	499

* p<0.05, **p<0.01, *** p<0.001

References

1. National Institute of Statistics of Rwanda, Macro International Inc. Rwanda Demographic and Health Survey 2005. In. Calverton, MD: Macro International; 2006.

2. National Institute of Statistics of Rwanda, Ministry of Health Rwanda, Inc. MI. Rwanda Interim Demographic and Health Survey 2007-2008. In. Calverton, MD: Macro International; 2009.

3. National Institute of Statistics of Rwanda, Ministry of Health Rwanda, ICF International. Rwanda Demographic and Health Survey 2010. In. Calverton, MD: NISR, MOH, and ICF International; 2012.

4. Government of Rwanda. Health Sector Strategic Plan 2005-2009. In. Ministry of Health (MINISANTE) Kigali, Rwanda.

5. United Nations. Resolution accepted by the General Assembly: 55/2 United Nations Millennium Declaration. Sept 18, 2000.

6. Hogan MC, Foreman KJ, Naghavi M, et al. Maternal mortality for 181 countries, 1980-2008: a systematic analysis of progress towards Millennium Development Goal 5. *Lancet* 2010;375(9726):1609-23.

7. Bhutta ZA, Chopra M, Axelson H, et al. Countdown to 2015 decade report (2000-10): taking stock of maternal, newborn, and child survival. *The Lancet* 2010;375(9730):2032-2044.

8. Rajaratnam JK, Marcus JR, Flaxman AD, et al. Neonatal, postneonatal, childhood, and under-5 mortality for 187 countries, 1970-2010: a systematic analysis of progress towards Millennium Development Goal 4. *Lancet* 2010;375(9730):1988-2008.

9. Bryce J, Daelmans B, Dwivedi A, et al. Countdown to 2015 for maternal, newborn, and child survival: the 2008 report on tracking coverage of interventions. *Lancet* 2008;371(9620):1247-58.

10. United Nations. Millennium Development Goals Indicators. Available at: http://unstats.un.org/unsd/mdg/Default.aspx. Accessed March 15 2012.

11. Gwatkin D, Rutstein S, Johnson K, Suliman E, Wagstaff A, Amouzou A. Socio-economic differences in health, nutrition, and population: Rwanda. In: *Country reports on HNP and Poverty*: The World Bank.; 2007.

12. Nationa Office of Population Rwanda, ORC Macro. Rwanda Demographic and Health Survey 2000, Key Findings. In. Calverton, MD, USA; 2001.

13. Institut National de la Statistique du Rwanda (INSR), ORC Macro. Rwanda Demographic and Health Survey 2005. In. Calverton, MD, USA: INSR and ORC Macro.; 2006.

14. Ministry of Health (MOH) [Rwanda], National Institute of Statistics of Rwanda (NISR), Macro. I. Rwanda Interim Demographic and Health Survey 2007-08. In. Calverton, MD, USA: MOH, NISR, and ICF Macro.; 2009.

15. Hong R, Ayad M, Rutstein S, Ren R. Childhood mortality in Rwanda: levels, trends, and differentials. In: *DHS Further Analysis Report*. Calverton, MD: ICF Macro; 2009.

16. Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS. How many child deaths can we prevent this year? *The Lancet* 2003;362(9377):65-71.

17. Bryce J, Terreri N, Victora CG, et al. Countdown to 2015: tracking intervention coverage for child survival. *Lancet* 2006;368(9541):1067-76.

18. Armstrong Schellenberg JR, Adam T, Mshinda H, et al. Effectiveness and cost of facility-based Integrated Management of Childhood Illness (IMCI) in Tanzania. *Lancet* 2004;364(9445):1583-94.

19. Gwatkin DR, Wagstaff A, Yazbeck A. Reaching the poor with health, nutrition, and population services: what works, what doesn't, and why: World Bank Publications; 2005.

20. Wagstaff A, Doorslaer Ev. Measuring and Testing for Inequity in the Delivery of Health Care. *The Journal of Human Resources* 2000;35(4):716-733.

21. Moser KA, Leon DA, Gwatkin DR. How does progress towards the child mortality millennium development goal affect inequalities between the poorest and least poor? Analysis of Demographic and Health Survey data. *BMJ* 2005;331(7526):1180-2.

22. Wagstaff A, Waters H. Chapter 2. How were the reaching the poor studies done? In: Gwatkin D, Wagstaff A, Yazbeck A, eds. *Reaching the Poor with Health, Nutrition and Population Services: What Works, What Doesn't, and Why*. Washington, D.C.: World Bank.; 2005:27-46.

23. Gwatkin DR. How much would poor people gain from faster progress towards the Millennium Development Goals for health? *The Lancet* 2005;365(9461):813-7.

24. Razzaque A, Streatfield PK, Gwatkin DR. Does health intervention improve socioeconomic inequalities of neonatal, infant and child mortality? Evidence from Matlab, Bangladesh. *Int J Equity Health* 2007;6:4.

25. Laterveer L, Niessen LW, Yazbeck AS. Pro-poor health policies in poverty reduction strategies. *Health Policy Plan* 2003;18(2):138-45.

26. The World Bank. World Development Report 2004: Making Services Work for Poor People. Washington, DC: The World Bank and Oxford University Press,; 2004.

27. Victora CG, Wagstaff A, Schellenberg JA, Gwatkin D, Claeson M, Habicht JP. Applying an equity lens to child health and mortality: more of the same is not enough. *The Lancet* 2003;362(9379):233-41.

28. Rogers EM. Diffusion of innovations: Free Pr; 1995.

29. Hart JT. The inverse care law. *The Lancet* 1971;297(7696):405-412.

30. Leon DA, Walt G. Poverty, inequality, and health: an international perspective: Oxford University Press; 2001.

31. Gwatkin DR. The need for equity-oriented health sector reforms. *International Journal of Epidemiology* 2001;30(4):720-3.

32. Gwatkin DR. Health inequalities and the health of the poor: what do we know? What can we do? *Bulletin of the World Health Organization* 2000;78(1):3-18.

33. Castro-Leal F, Dayton J, Demery L, Mehra K. Public spending on health care in Africa: do the poor benefit? *Bull World Health Organ* 2000;78(1):66-74.

34. Burton DC, Flannery B, Onyango B, et al. Healthcare-seeking behaviour for common infectious disease-related illnesses in rural Kenya: a community-based house-to-house survey. *J Health Popul Nutr* 2011;29(1):61-70.

35. Schellenberg JA, Victora CG, Mushi A, et al. Inequities among the very poor: health care for children in rural southern Tanzania. *The Lancet* 2003;361(9357):561-6.

36. Schwartz JB, Bhushan I. Chapter 8. Cambodia: using contracting to reduce inequity in primary health care delivery. In: *Reaching the Poor with Health, Nutrition, and Population Services: What Works, What Doesn't, and Why*; 2005:137–62.

37. Chandrasekhar S, Gebreselassie T, Jayaraman A. Maternal Health Care Seeking Behavior in a Post-Conflict HIPC: The Case of Rwanda. *Population Research and Policy Review* 2011;30(1):25-41.

38. Taffa N, Chepngeno G. Determinants of health care seeking for childhood illnesses in Nairobi slums. *Trop Med Int Health* 2005;10(3):240-5.

39. Ogunlesi TA, Olanrewaju DM. Socio-demographic factors and appropriate health care-seeking behavior for childhood illnesses. *J Trop Pediatr* 2010;56(6):379-85.

40. Amin R, Shah NM, Becker S. Socioeconomic factors differentiating maternal and child health-seeking behavior in rural Bangladesh: A cross-sectional analysis. *Int J Equity Health* 2010;9:9.

41. Boerma JT, Bryce J, Kinfu Y, Axelson H, Victora CG. Mind the gap: equity and trends in coverage of maternal, newborn, and child health services in 54 Countdown countries. *The Lancet* 2008;371(9620):1259-67.

42. Office National de la Population, ORC Macro. Rwanda Demographic and Health Survey 1992. In. Calverton, MD, USA: ORC Macro; 1994.

43. Office National de la Population, Institut National de la Statistique du Rwanda (INSR), ORC Macro. Rwanda Demographic and Health Survey 2000, Key Findings. In. Calverton, MD, USA: ORC Macro; 2001.

44. Eichler R, Levine R, Performance-Based Incentives Working Group. Performance incentives for global health: potential and pitfalls. Washington,D.C.: Center for Global Development; 2009.

45. Beauliere A, Le Maux A, Trehin C, Perez F. Access to antiretroviral treatment in developing countries: Which financing strategies are possible? *Revue d'epidemiologie et de sante publique* 2010;58(3):171-179.

46. Basinga P. Impact of performance-based financing on the quantity and quality of maternal health services in Rwanda. New Orleans: Tulane University; 2009.

47. Logie DE, Rowson M, Ndagije F. Innovations in Rwanda's health system: looking to the future. *Lancet* 2008;372(9634):256-261.

48. Eichler R. Can "pay for performance" increase utilization by the poor and improve the quality of health services. *Background papers for the Working Group on Performance Based Incentives. Centre for Global Development* 2006.

49. Musgrove P. Rewards for good performance or results: a short glossary. In. Washington, D.C.: The World Bank; 2011.

50. Canavan A, Toonen J, Elovainio R. Performance based financing: an international review of the literature. In: Royal Tropical Institute (KIT). Development Policy & Practice; 2008.

51. Meessen B, Soucat A, Sekabaraga C. Performance-based financing: just a donor fad or a catalyst towards comprehensive health-care reform? *Bulletin of the World Health Organization* 2011;89(2):153-156.

52. Eldridge C, Palmer N. Performance-based payment: some reflections on the discourse, evidence and unanswered questions. *Health policy and planning* 2009;24(3):160-166.

53. Hecht R, Batson A, Brenzel L. Making health care accountable. *Health and development: a compilation of articles from Finance & development* 2004:16.

54. Liu X, Hotchkiss DR, Bose S. The effectiveness of contracting-out primary health care services in developing countries: a review of the evidence. *Health policy and planning* 2008;23(1):1-13.

55. Loevinsohn B, Harding A. Buying results? Contracting for health service delivery in developing countries. *Lancet* 2005;366(9486):676-681.

56. Huntington D, Zaky HH, Shawky S, Fattah FA, El-Hadary E. Impact of a service provider incentive payment scheme on quality of reproductive and child-health services in Egypt. *Journal of health, population, and nutrition* 2010;28(3):273-280.

57. Busogoro J, Beith A. Pay-for-performance for improved health in Burundi. In. Bethesda, Maryland: Health Systems 20/20 Project, Abt Associates Inc.; 2010.

58. Kalk A, Paul FA, Grabosch E. 'Paying for performance' in Rwanda: does it pay off? *Trop Med Int Health* 2010;15(2):182-190.

59. Eichler R, Auxila P, Antoine U, Desmangles B. Chapter 9. Haiti: Going to Scale with a Performance Incentive Model. In: Eichler R, Levine R, Performance-Based Incentives Working Group, eds. *Performance Incentives for Global Health: Potential and Pitfalls.* Washingtion, D.C.: Center for Global Development; 2009:165–188.

60. Soeters R, Griffiths F. Improving government health services through contract management: a case from Cambodia. *Health policy and planning* 2003;18(1):74-83.

61. Basinga P, Gertler PJ, Binagwaho A, Soucat AL, Sturdy J, Vermeersch CM. Effect on maternal and child health services in Rwanda of payment to primary health-care providers for performance: an impact evaluation. *The Lancet* 2011;377(9775):1421-8.

62. Rusa L, Ngirabega Jde D, Janssen W, Van Bastelaere S, Porignon D, Vandenbulcke W. Performance-based financing for better quality of services in Rwandan health centres: 3-year experience. *Trop Med Int Health* 2009;14(7):830-837.

63. Rusa L, Schneidman M, Fritsche G, Musango L, Eichler R, Levine R. Chapter 10. Rwanda: Performance-based financing in the public sector. In: Eichler R, Levine R, Performance-Based Incentives Working Group, eds. *Performance incentives for global health: potential and pitfalls*. Washington, D.C.: Center for Global Development; 2009:189-214.

64. Toonen J. CA, Vergeer P., Elovainio R. Learning lessons on implementing performance based financing from a multi-country evaluation. In: KIT Royal Tropical Institue, in collaboration with Cordaid and World Health Organization; 2009.

65. Cercone J, Briceno R, Gauri V. Contracting primary health care services - the case of Costa Rica. In: La Forgia G, ed. *Health System Innovations in Central America: lessons and impact of new approaches*. Washington, D.C.: World Bank; 2005.

66. Soeters R, Habineza C, Peerenboom PB. Performance-based financing and changing the district health system: experience from Rwanda. *Bulletin of the World Health Organization* 2006;84(11):884-889.

67. Meessen B, Musango L, Kashala JP, Lemlin J. Reviewing institutions of rural health centres: the Performance Initiative in Butare, Rwanda. *Trop Med Int Health* 2006;11(8):1303-1317.

68. Management Sciences for Health. Rwanda HIV/PBF Project. Available at: http://www.msh.org/global-presence/rwanda-hiv-pbf-project.cfm. Accessed May 2011.

69. Basinga P, Mayaka S, Condo J. Performance-based financing: the need for more research. *Bulletin of the World Health Organization* 2011;89(9):698-9.

70. Soeters R, Peerenboom PB, Mushagalusa P, Kimanuka C. Performance-based financing experiment improved health care in the Democratic Republic of Congo. *Health Affairs* 2011;30(8):1518-27.

71. Montagu D, Yamey G. Pay-for-performance and the Millennium Development Goals. *The Lancet* 2011;377(9775):1383-5.

72. Ireland M, Paul E, Dujardin B. Can performance-based financing be used to reform health systems in developing countries? *Bulletin of the World Health Organization* 2011;89(9):695-8.

73. Gwatkin D. Ensuring that the poor share fully in the benefits of results-based financing program in health. In: The World Bank, ed. *Results-Based Financing for Health*; 2009.

74. Witter S, Fretheim A, Kessy FL, Lindahl AK. Paying for performance to improve the delivery of health interventions in low-and middle-income countries. *Cochrane Database of Systematic Reviews* 2012(2):1-83.

75. Ireland M, Paul E, Dujardin B. Can performance-based financing be used to reform health systems in developing countries? *Bull World Health Organ* 2011;89(9):695-8.

76. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav* 1995;36(1):1-10.

77. Bell J, Curtis SL, Alayón S. Trends in delivery care in six countries. In: *DHS Analytical Studies No.7*. Calverton, MD: ORC Macro; 2003:62.

78. Stephenson R, Baschieri A, Clements S, Hennink M, Madise N. Contextual influences on the use of health facilities for childbirth in Africa. *Am J Public Health* 2006;96(1):84-93.

79. Nikiema B, Beninguisse G, Haggerty JL. Providing information on pregnancy complications during antenatal visits: unmet educational needs in sub-Saharan Africa. *Health Policy Plan* 2009;24(5):367-76.

80. Mishra V, Retherford RD. The effect of antenatal care on professional assistance at delivery in rural India. *Population Research and Policy Review* 2008;27(3):307-320.

81. Mpembeni RN, Killewo JZ, Leshabari MT, et al. Use pattern of maternal health services and determinants of skilled care during delivery in Southern Tanzania: implications for achievement of MDG-5 targets. *BMC Pregnancy Childbirth* 2007;7:29.

82. Gabrysch S, Campbell OM. Still too far to walk: literature review of the determinants of delivery service use. *BMC Pregnancy Childbirth* 2009;9:34.

83. Stephenson R, Tsui AO. Contextual influences on reproductive health service use in Uttar Pradesh, India. *Stud Fam Plann* 2002;33(4):309-20.

84. Ahmed S, Khan MM. Is demand-side financing equity enhancing? Lessons from a maternal health voucher scheme in Bangladesh. *Soc Sci Med* 2011;72(10):1704-10.

85. Uchidi J. Covariates of child mortality in Mali: Does the health-seeking behaviour of the mother matter? *Journal of biosocial science* 2001;33(01):33-54.

86. Pillai VK, Teboh C. A decade of contraceptive use in Cameroon: influences of structural changes. *Open Access Journal of Contraception* 2011;2:5-11.

87. The World Factbook: Rwanda. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/rw.html#top. Accessed July 15 2011.

88. O'Donnell O, Van Doorsslaer E, Wagstaff A, Lindelöw M. Analyzing health equity using household survey data: a guide to techniques and their implementation: World Bank Publications; 2008.

89. World Health Organization. Standards for maternal and neonatal care. In. Geneva, Switzerland: World Health Organization; 2007:1-72.

90. Kolenikov S, Angeles G. Socioeconomic status measurement with discrete proxy variables: is principal component analysis a reliable answer? *Review of Income and Wealth* 2009;55(1):128-165.

91. Rowe AK, de Savigny D, Lanata CF, Victora CG. How can we achieve and maintain high-quality performance of health workers in low-resource settings? *The Lancet* 2005;366(9490):1026-35.

92. Serneels P, Lievens T. Institutions for health care delivery: a formal exploration of what matters to health workers: evidence from Rwanda. In: *The Centre for the Study of African Economies Working Paper Series, Working Paper 309*; 2008:1-31.

93. National Office of Population (Rwanda), Macro International Inc. Rwanda Demographic and Health Survey 2000, Key Findings. In. Calverton, MD: Macro International, Inc.; 2001.

94. Victora CG, Vaughan JP, Barros FC, Silva AC, Tomasi E. Explaining trends in inequities: evidence from Brazilian child health studies. *The Lancet* 2000;356(9235):1093-8.

95. Hong R, Ayad M, Ngabo F. Being insured improves safe delivery practices in Rwanda. *Journal of Community Health* 2011;36(5):779-84.

96. Dhillon RS, Bonds MH, Fraden M, Ndahiro D, Ruxin J. The impact of reducing financial barriers on utilisation of a primary health care facility in Rwanda. *Global Public Health* 2012;7(1):71-86.

97. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. *Demography* 2001;38(1):115-32.

98. Rutstein S. The DHS Wealth Index: approaches for rural and urban areas. In: *DHS Working Papers, No.60*. Calverton, MD: Macro International Inc.; 2008:1-28.

99. Speizer I, Luseno W. Measuring and interpreting urban fertility and family planning indicators by wealth in two south Asian countries. In: *MEASURE Evaluation Working Papers*. Chapel Hill, NC: MEASURE Evaluation; 2010:1-19.

100. Otten M, Aregawi M, Were W, et al. Initial evidence of reduction of malaria cases and deaths in Rwanda and Ethiopia due to rapid scale-up of malaria prevention and treatment. *Malar J* 2009;8:14.

101. Rwanda Ministry of Health. Quarterly quality assessment grid for health centers. In; 2008.

102. Schneider P, Hanson K. Horizontal equity in utilisation of care and fairness of health financing: a comparison of micro-health insurance and user fees in Rwanda. *Health economics* 2006;15(1):19-31.

103. Saksena P, Antunes AF, Xu K, Musango L, Carrin G. Mutual health insurance in Rwanda: evidence on access to care and financial risk protection. *Health policy (Amsterdam, Netherlands)* 2011;99(3):203-209.

104. Sekabaraga C, Diop F, Soucat A. Can innovative health financing policies increase access to MDG-related services? Evidence from Rwanda. *Health Policy and Planning* 2011;26 Suppl 2:ii52-62.

105. Kagubare M. The impact of community-based health insurance on health care utilization and financial sustainability: The example of Rwanda: Johns Hopkins University; 2006.

106. Haines A, Sanders D, Lehmann U, et al. Achieving child survival goals: potential contribution of community health workers. *Lancet* 2007;369(9579):2121-31.

107. Liu A, Sullivan S, Khan M, Sachs S, Singh P. Community health workers in global health: scale and scalability. *Mt Sinai J Med* 2011;78(3):419-35.

108. Danel I, La Forgia G. Contracting for basic health care in rural Guatemala: comparison of the performance of three delivery models. In: La Forgia G, ed. *Health Systems Innovations in Central America: Lessons and Impact of New Approaches*. Washington, D.C.: The World Bank; 2005:49–88.

109. Schwartz JB, Bhushan I. Improving immunization equity through a public-private partnership in Cambodia. *Bulletin of the World Health Organization* 2004;82(9):661-667.

110. Victora CG, Black RE, Boerma JT, Bryce J. Measuring impact in the Millennium Development Goal era and beyond: a new approach to large-scale effectiveness evaluations. *Lancet* 2011;377(9759):85-95.

111. Brown CA, Lilford RJ. The stepped wedge trial design: a systematic review. *BMC Med Res Methodol* 2006;6:54.