

Beyond 80%: Are There New Ways of Increasing Vaccination Coverage?

Evaluation of CCT Programs in Mexico and Nicaragua

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Health, Nutrition and Population (HNP) Discussion Paper

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Abstract:

In recent years there has been significant global effort to scale-up immunization programs to achieve higher levels of vaccine coverage against major childhood diseases. However, coverage disparities still exist not only between, but within countries, and traditional supply-side program strategies may not be sufficient to achieve coverage goals. Conditional cash transfer (CCT) programs are an innovative social assistance mechanism that provides cash transfers to poor families, conditional on their use of preventive health care services and children's regular school attendance. A primary objective of CCTs is to break the inter-generational transmission of poverty by improving the human capital of the poorest households.

This study evaluates the impact of the Mexican CCT program, *Oportunidades* and the Nicaraguan program, *Red de Protección Social*, on vaccination coverage for BCG, DPT, OPV and MCV in children less than three years of age, using a randomized treatment and control design at the community level. The intent-to-treat effect on vaccination coverage is assessed using a double-difference estimator.

This study found that in Mexico and Nicaragua, CCTs significantly contribute to increased vaccination coverage among children, particularly among those not reached by traditional program strategies, such as children living further from health facilities and with mothers having less than primary school. Six months after its introduction, implementation of *Oportunidades* in Mexico was associated with a statistically significant 5 percentage point increase in BCG coverage rates and a 3 percentage point increase in MCV coverage for on-time vaccination. Five months after the introduction of the health component in Nicaragua, the program impact led to a statistically significant increase in on-time vaccinations for OPV3 coverage (13 percentage points or 17 percent) and fully vaccinated children (20 percentage points or 37 percent).

Program effects are seen in high and low coverage settings, as well as in low- and middle-income countries. CCTs need to be considered as one of the possible strategies that national immunization programs can use to strengthen vaccination coverage, particularly among hard-to-reach populations. The global immunization community needs to increase its awareness of CCTs and their possible role in achieving MDG4.

Keywords: Conditional cash transfer programs, vaccination, Latin America

Disclaimer: The findings, interpretations and conclusions expressed in the paper are entirely those of the authors, and do not represent the views of the World Bank, its Executive Directors, or the countries they represent.

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
BCG	Bacille Calmette-Guérin (vaccine against tuberculosis)
CCT	Conditional Cash Transfer
DPT	Diphtheria-Pertussis-Tetanus Vaccine
DPT3	Third dose of DPT vaccine
EAP	East Asia and the Pacific
ECA	Eastern Europe and Central Asia
EPI	Expanded Programme on Immunization
ESW	Economic and Sector Work
FVC	Fully Vaccinated Child
GAVI	Global Alliance for Vaccines and Immunization
GIVS	Global Immunization Vision and Strategy
HepB	Hepatitis B Vaccine
Hib	Haemophilus Influenza type B Vaccine
HIV	Human Immunodeficiency Virus
IFFIm	International Finance Facility for Immunization
LAC	Latin America and the Caribbean
MCV	Measles-Containing Vaccine
MDG	Millennium Development Goal
MENA	Middle East and North Africa
MMR	Measles-Mumps-Rubella vaccine
NGO	Non-governmental Organization
OLS	Ordinary Least Squares Regression
OPV	Oral Polio Vaccine
OPV3	Third dose of Oral Polio Vaccine
PAHO	Pan American Health Organization
PBL	Post Baseline
PHC	Primary Health Care
RED	Reaching Every District
RPS	Red de Protección Social
SA	South Asia
SE	Standard Error
SSA	Sub-Saharan Africa
UCI	Universal Childhood Immunization
UN	United Nations
UNICEF	United Nations Children's Fund
WHO	World Health Organization

PART I - INTRODUCTION

The Unfinished Agenda of Immunization Coverage

The adoption of the Millennium Development Goals (MDGs) at the UN General Assembly in 2000 underscored the need to strengthen immunization programs to increase coverage for achieving the Child Health MDG (MDG4). Over the past twenty-five years, there have been significant national, regional, and global efforts to vaccinate children against major childhood diseases,¹ with substantial progress having been made. For example, in 2005, global vaccination coverage of the third dose of the Diphtheria-Pertussis-Tetanus Vaccine (DPT3) was 78% and of measles containing vaccine (MCV), 77%. Nevertheless, approximately 28 million children worldwide remained inadequately immunized (WHO, 2006b). Of these, 12.1 million children resided in Southeast Asia, 8.7 million children in Africa, and 1 million in Latin America and the Caribbean (LAC).²

Table 1 provides coverage rates by region for DPT3 and MCV in 2005. Sub-Saharan Africa and Southeast Asia have the lowest coverage rates in the world while the European and LAC regions have the highest.

Table 1: Regional Coverage Rates for DPT3 and MCV Vaccines, 2005

Region	DPT3	MCV
Sub-Saharan Africa	67	65
Latin America and the Caribbean	93	93
Eastern Mediterranean	82	82
European	95	93
Southeast Asia	66	65
Western Pacific	87	87
Global	78	77

Sources: Adapted from WHO, 2006b; PAHO, 2007.

The comparatively high average coverage rates for LAC, however, mask large differences across countries within the region. For example, while Bolivia, and Nicaragua do have good coverage of BCG (against tuberculosis), they are behind other countries in the region for the third dose of oral polio vaccine (OPV3) and DPT3.

In addition to variation across countries in LAC, there is also significant variation within countries. On average, 62% of municipalities in Latin America have coverage rates for MCV above 95%. Table 2, however, shows that more than 95% of municipalities in

¹ These include DPT (diphtheria, pertussis, and tetanus), polio, tuberculosis, and measles.

² For many vaccines, near universal levels of coverage are needed to reduce disease transmission to susceptible populations. In particular, the measles containing vaccine requires at least 95% coverage to fully protect a community from disease transmission.

Mexico have coverage rates above 95% for MCV, compared to Nicaragua where only 22% do. Since average coverage of MCV in Nicaragua as a whole is above 95%, this indicates that it is the more rural and sparsely populated municipalities that are poorly covered.

Table 2: Coverage Rates in Selected Latin American and Caribbean Countries, 2005

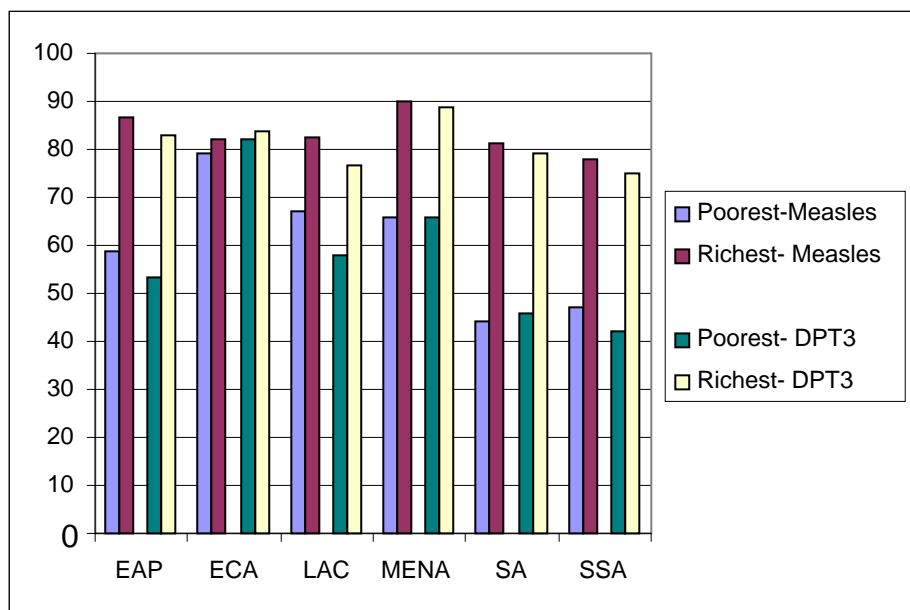
Country	BCG	OPV3	DPT3	MCV	Percentage of Municipalities with Coverage \geq 95% for MCV	Number of Municipalities
Bolivia	88	84	85	89	25	324
Brazil	99	98	96	99	62	5,564
Chile	95	92	91	90	49	345
Haiti	62	65	68	59	25	133
Honduras	91	91	91	92	43	298
Mexico	99	98	98	96	96	2,444
Nicaragua	99	87	86	96	22	162
Paraguay	88	87	87	90	41	232

Source: PAHO, 2007.

Not only are there differences in vaccination coverage rates across geographic areas, with low coverage in certain areas, and coincident to this, among certain ethnic groups (PAHO, 2007), but there are also disparities by household income level (Gwatkin and Deveshwar-Bahl, 2001; Qamruddin, et al., 2006). Figure 1 shows inequities in MCV and DPT3 coverage for the poorest and richest households in the LAC region. The rich-poor ratios are 1.5 on average for the region (Gwatkin and Deveshwar-Bahl, 2001).

Despite high average coverage rates in some areas, then, there is an unfinished agenda with respect to full vaccination coverage both in LAC and worldwide. Disparities in coverage exist not only across countries and regions, but also within countries in ways that are correlated with geographic location (isolation) and household socio-economic characteristics.

Figure 1: Regional Average MCV and DPT3 Coverage Rates for Lowest and Highest Income Quintiles



Source: Qamruddin et al., 2006.

Strategies for Increasing Coverage

There are several possible approaches—both supply- or demand-oriented—to increasing immunization coverage and reaching the desired targets. At the country level, governments are introducing new planning methods that should aid in identifying cost-effective strategies for achieving higher immunization coverage. For example, 53 countries have implemented the reaching every district (RED) strategy, WHO’s main strategy for increasing routine immunization coverage (WHO, 2006a). RED includes several distinct components: planning at the district level to identify ways to improve routine program performance, for example by establishing regular outreach services; building stronger community links with service delivery; supporting supervision (on-site training); monitoring and using data for action; and improving planning and management of human and financial resources.

In response to challenges in global immunization, WHO and UNICEF developed the Global Immunization Vision and Strategy (GIVS) 2006–2015, which was adopted in 2005 by member governments at the World Health Assembly. The GIVS outlines approximately 25 possible strategies for achieving higher coverage goals, and it is hoped that these strategies will increase vaccination coverage to at least 90% at the national level and at least 80% in every district by 2010. Protecting more people in a changing world, particularly hard-to-reach populations, is one of the strategic areas of the GIVS.

This involves increasing community demand for vaccination, among other activities (WHO, 2005a; WHO and UNICEF, 2005).

One major constraint plaguing immunization efforts in recent years has been the lack of stable, predictable, and coordinated funding (Foster, 2005). To address this problem, significant funding has been generated at the global level. The GAVI Alliance³ has committed nearly \$1.5 billion to 73 of the world's poorest countries (those with a GNI/capita less than \$1000). Of this amount, more than \$1 billion so far has been committed for the introduction of new and underused vaccines and safe injection commodities. Some of the current funding for the GAVI Alliance comes from the International Finance Facility for Immunization (IFFIm) launched in November 2006. The IFFIm is expected to generate predictable funding flows for immunization over the next 10 years of up to \$4 billion in resources (GAVI, 2007). These additional resources will go a long way towards improving outreach services and increasing the supply of new vaccines.

Supply and Demand Issues Affecting Immunization Coverage

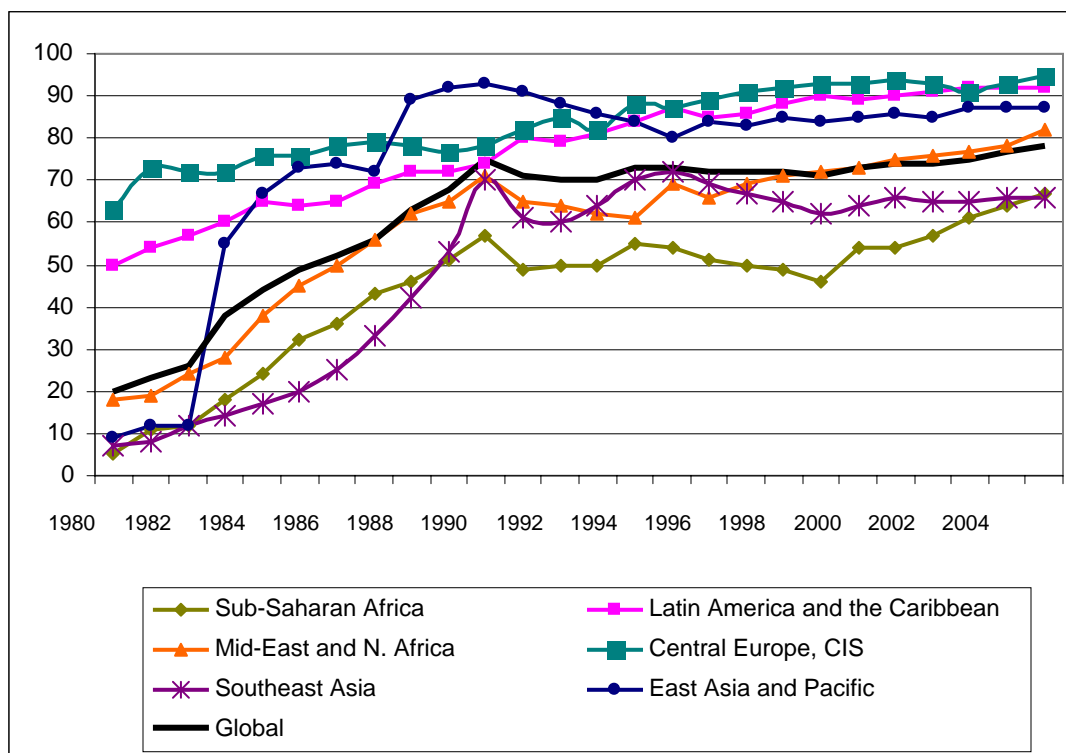
Even with these successful efforts to improve financing, significant challenges remain to cover all children with available vaccines. Figure 2 shows that apart from two best performing regions, the others either have reached or are expected to reach a “plateau” below 90% coverage, based on current strategies for vaccinating children.

Coverage rates may cease to increase and level off over time due to constraints in both supply- and demand-side factors. Supply-side factors include the availability and distribution of safe and effective vaccines; national-level logistics and storage systems; adequate and reliable financing; qualified, trained, and motivated health personnel; adequate planning and supervision; and monitoring and surveillance. Currently, most national and global efforts are focused on addressing supply-side constraints to achieve higher coverage rates.

There are also a number of important demand-side factors. Increasing community demand has focused mainly on communication and social mobilization strategies rather than on overcoming the social and economic constraints to full immunization. Reaching higher coverage levels also will require a better understanding of why families do or do not vaccinate their children. However, behavioral factors that affect the use of preventive services have not been adequately studied for immunization (Pillsbury, 1990). As such, potentially powerful mechanisms for achieving higher coverage rates may have been overlooked.

³ Formerly the Global Alliance for Vaccines and Immunization (GAVI).

Figure 2: Trends in Immunization Coverage Rates by Region for DPT3



Source: WHO, 2006c.

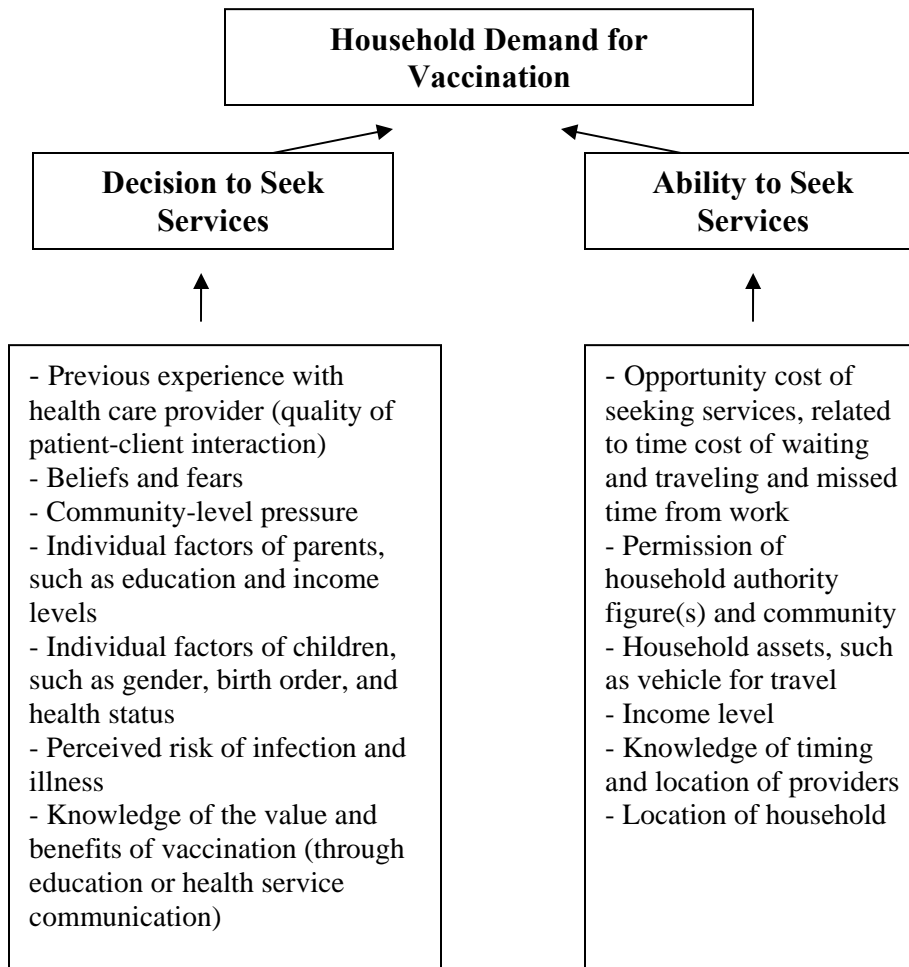
Figure 3 categorizes factors affecting household demand for immunization in two ways—those factors related to the decision to seek services, and those factors affecting the ability to seek services. A variety of individual and household level factors influence the decision to immunize children. These include: education and income levels of the parents (and particularly of mothers); knowledge of the value and benefits of immunization; and the age, gender, birth order and health status of the children (Hanlon et al., 1988; Nichter et al., 1995; Streefland et al., 1999). In addition, trust in modern medicine has been found to be an important facilitating factor in use of vaccination services (Hanlon et al., 1988; Nichter et al., 1995). The ability to seek immunization services is related to the opportunity costs of time and household income, among other factors.

Decision-making to seek child care, such as vaccination, is not a straight-forward process within the household. There is a growing body of literature that suggests that resource allocation decisions made by women result in different consumption patterns for both food and health care than decisions taken by men (Thomas, 1992; Haddad, 1992; Brenzel, 1995). This finding has implications for how a specific demand-side intervention might be structured in order to maximize child health benefits.

Accepting the importance of immunization does not guarantee that a household will access available services. There are a number of factors which affect the ability to seek services. Factors which increase the opportunity cost of seeking services, such as travel and waiting time costs and missing time from work, particularly for self-employed

women (Hanlon et al., 1988; Cassell et al., 2006; Streefland et al., 1999; Pillsbury, 1990) are deterrents to demand for immunization services. In addition, demand for services has been found to be lower in households with lower income and wealth (Cassell et al., 2006). Other household factors such as permission of household authority figures and knowledge of location and timing of sessions are important as well (Hanlon et al., 1988; Streefland et al., 1999; Nichter et al., 1995). Some researchers have found differences with respect to location of the household, with rural households having better compliance and use of services than their urban counterparts (Cassell et al., 2006).

Figure 3: Factors Affecting Household Demand for Immunization



Demand for childhood vaccination services relates to a range of factors that affect both the decision to seek vaccination services and the ability to seek services. Strategies and interventions which address these factors are likely to have an impact on vaccination coverage.

Policy and Program Responses to Immunization Demand-Side Issues

Table 3 outlines strategies and possible areas of intervention for improving household demand for immunization services.

Table 3: Possible Strategies for Improving Household Demand for Immunization

Factor	Possible Areas of Intervention	Currently Undertaken?
Quality of provider-client interactions	Studies on patient perceptions of quality and interventions to improve them	Yes
	Training to improve quality of immunization services and demeanor of providers	Yes
	Performance-based incentives to providers to improve quality of interactions	Somewhat
Superstitious beliefs and fears, perceived risks and benefits; knowledge of the value of vaccinations; and community-level pressures	Public, provider-level and community-level education; social mobilization efforts	Somewhat
	Financial incentives to households to overcome latent beliefs and perceived risks	Voucher and cash transfer programs
Knowledge of timing and location of providers	Social mobilization efforts	Yes
Opportunity costs of waiting, traveling and missing employment	Increase number and nearness of locations	Yes
	Conduct outreach services; include performance-based incentives for outreach services	Yes
	Improve management of patient flows or change immunization session timings	Yes
	Provide incentives to households to compensate for lost time and wages	Voucher and cash transfer programs
Household income and education levels	Provide financial incentives to households	Voucher and cash transfer programs

Several of these interventions and strategies already are incorporated into national immunization programs. For instance, social mobilization activities have been undertaken to improve coverage levels, particularly during national and sub-national vaccine campaigns. Social mobilization, as defined by UNICEF, is a broad scale movement to engage the population's participation in achieving a specific development goal through self-reliant efforts. It involves all relevant segments of society, from decision and policy

makers, opinion leaders, and bureaucrats to religious associations, communities and individuals. Social mobilization is a planned, decentralized process that seeks to facilitate change by taking into account the felt needs of the people. At the policy level, social mobilization aims to empower communities to act at the grassroots level. Outcomes are people's active involvement in achieving the development objective (UNICEF, 1996).

Social mobilization with the use of mass media has had some impact on raising immunization awareness, although one study in Niger found a lack of understanding regarding the rationale for national immunization days after a social mobilization effort (Gage, 2003). Social mobilization has also been linked to increased use of immunization services. However, these effects tend to be time-limited and associated with campaign strategies.

While there has been some attention paid to social mobilization, particularly around campaigns and conveying information on schedules and need for vaccination, there has been limited attention paid to other demand-side strategies to improve immunization coverage. For instance, the GIVS does not discuss nor recommend approaches to provide financial incentives to households to compensate for lost time and work traveling with children to vaccination sessions. Yet, approaches such as voucher schemes and conditional cash transfer (CCT) programs have been implemented successfully in both middle- and low-income countries in all regions of the world.

In the rest of this paper, findings from two studies evaluating the impact of CCTs on immunization coverage rates are presented and discussed. The evidence indicates that these types of mechanisms have significant potential to help countries expand beyond coverage plateaus, and to equalize coverage rates between different population groups.

Conditional Cash Transfer Programs as a Tool for Increasing Immunization Coverage

Conditional cash transfer programs are an innovative social assistance mechanism that provides cash transfers to poor families, usually conditional on their use of preventive health care services and children's regular school attendance (Gertler, 2000). A primary objective of CCTs is to break the inter-generational transmission of poverty by improving the human capital of the poorest households. The conditional income transfer of a CCT not only relaxes the household budget constraint, but also aims to improve the health, nutrition, and education of household members.

While initially implemented in middle-income countries in LAC, CCT programs currently exist in both low- and middle-income countries throughout the world. A recent World Bank assessment finds more than 23 countries with active or pilot CCTs and 19 countries with CCTs in the exploratory stage (CCT Task Force, World Bank, 2007).

There is no "standard" CCT program and the objectives, conditionalities, and institutional arrangements vary according to country context. Some CCTs (e.g., Jamaica, Kenya, and

South Africa) have specific objectives, such as the care of HIV/AIDS orphans, vulnerable children, the elderly, or disabled populations. Some programs are initiated as pilots and others have wider geographic distribution from the start. Program size ranges from 11 million households in Brazil to only 10,000 households in South Africa.

CCTs also have been implemented in countries where health care systems are weak, so that parallel investments and strategies have been necessary to support the health care system to deliver quality services related to the conditionalities. For instance, in Nicaragua, contracts were made with private providers to provide health care services to beneficiaries as part of the CCT.

Annex 1 compares the health and nutrition components of CCTs in selected countries. Most programs emphasize maintaining a schedule of preventive care visits, including well-baby visits, antenatal care, and vaccination. A few programs also include postpartum care and follow-up. The program in Kenya includes vitamin A supplementation and the program in Peru involves de-worming of children.

CCTs have demonstrated substantial impacts on the health and well-being of beneficiary populations. A review of Latin American programs found resources were targeted to the poor, and that CCTs were more pro-poor than other major social assistance programs. On average, 81% of CCT program benefits go to the poorest 40% of families (Coady et al., 2004).

Evaluation results show that CCTs have been successful at increasing the demand for health care services, which is highlighted by the increase in utilization of preventive health care services. In Honduras, there was a marked increase in up-take of antenatal care and routine well-child check-ups by 18–20 percentage points (Morris et al., 2004). Utilization of public health clinics increased faster in intervention areas in Mexico (Gertler, 2000). Utilization of growth monitoring visits by program beneficiaries showed marked increases in Mexico, Colombia, Honduras, and Nicaragua (Gertler, 2000; Morris et al., 2004; Rawlings, 2004). In Nicaragua, growth monitoring increased from about 60% to more than 90% in CCT program areas (Maluccio and Flores, 2005).

Evaluation results have also shown that child health outcomes have improved as a result of the CCTs. For example, CCT programs were effective in improving the nutritional status of young children in Colombia, Nicaragua, and Mexico (Attanasio et al., 2005; Behrman and Hoddinott, 2001; Gertler, 2000; Gertler, 2004, Maluccio and Flores, 2005; Rivera, 2004), in reducing acute diarrhea episodes in Colombia (Attanasio et al., 2005), and in decreasing the rural infant mortality rate in Mexico (Barham, 2006).

There is one previous study that examined the impact of CCTs on vaccination coverage in Honduras (Morris et al., 2004). This study showed there was increased DPT3 coverage at appropriate ages, but no effect on coverage for MCV or tetanus for women.

PART II – THE CURRENT STUDY

Oportunidades and Red de Protección Social

This study evaluates the impact of the Mexican CCT program (*Oportunidades*)⁴ and the Nicaraguan program (*Red de Protección Social—RPS*) on vaccination coverage for selected vaccines in children less than three years of age, using a randomized treatment and control design at the community level.

The health components in both countries focused on a package of preventive services for infants, children, and pregnant and lactating women.⁵ For families to receive their bi-monthly health transfers, children had to attend regular preventive health care and growth monitoring visits. During these regularly scheduled visits, children were to receive the appropriate vaccinations based on their age. An additional conditionality required a designated household representative (in most cases, the mother) to attend health education talks held every other month. During this time, or during the regular health care visits, the importance of vaccination and child health were discussed.

While the health conditions of both programs were designed to promote family health and nutrition, there are important differences between them related to the mechanisms for delivering health care.

The *Oportunidades* Program in Mexico

Oportunidades began in 1997 in rural areas of Mexico and is the longest running CCT program. Beneficiaries are required to use the government health care clinic or mobile health clinic. Both to improve access to health care and to meet the expected increase in demand, the Mexican government expanded mobile clinics in beneficiary areas (Adato et al., 2000). Box 1 describes the program in more detail.

To evaluate the impact of *Oportunidades*, the Mexican government designed a randomized experiment using a subset of eligible communities. In 1998, 506 of the approximately 50,000 eligible villages were chosen to participate in the experiment. These communities were located in 7 states throughout Mexico.⁶ The government randomly assigned 320 communities to treatment areas (beneficiaries of the cash transfer) and 186 to control areas.⁷ Only poor households were eligible for benefits. Eligible households in treatment areas received benefits starting in the spring of 1998, while eligible households in control areas were incorporated about two years later (Gertler,

⁴ Formerly known as *Progresa: Programa de Educación, Salud y Alimentación*.

⁵ See Skoufias (2005) and Maluccio and Flores (2005) for a more detailed description of the *Oportunidades* and *RPS* programs respectively.

⁶ See Skoufias, Davis and Behrman (1999) for a detailed description of the targeting procedures for selecting communities and eligible households for the *Oportunidades* program.

⁷ The delay in implementation of the program in control villages was justified since at the outset the government lacked sufficient funds to provide the program nationally.

2000). The bi-monthly transfers represented approximately 20% of household expenditures on average (Skoufias, 2005).

The Mexico evaluation data set comprises a panel of approximately 24,000 households covering the period October 1997 to October 2000. Baseline household surveys were taken in October 1997 and May 1998, and five follow-up surveys (or post baseline—PBL) were implemented at approximately six-month intervals. Surveys were carried out for all households in treatment and control communities, so that the data set comprises a census of each community.

Vaccination data were collected in the May 1998 baseline survey, the first follow-up (6 months PBL) in October 1998, and the second follow-up (12 months PBL) in May 1999. For the analysis, we rely on an unbalanced panel of beneficiary children under the age of three in any of the three surveys.⁸ This yields a sample of 19,663 observations—12,260 of which are from treatment villages. Data from community surveys are incorporated as the source of health clinic information for this study.

⁸ The survey covered everyone in a community. However, only those households which were considered poor were eligible for the program and are included in our analyses.

Box 1: The *Oportunidades* Program in Mexico

Objective: Begun in 1997, the purpose of the *Oportunidades* program is to develop human capital in low-income households in the poorest areas of Mexico through a multi-sectoral approach and investment in nutrition, health, and education. Addressing multiple dimensions of human capital simultaneously and synergistically is hoped to result in greater social returns in the future.

Coverage: The program scaled up rapidly, covering approximately 2.6 million families (40% of rural families) by 2000. By 2005, *Oportunidades* covered about 5 million low-income households in both rural and urban areas or 20 percent of the population.

Health and Nutrition Component: The program focuses on four inter-related health components: 1) a basic package of primary health care services; 2) nutrition and health education for families and communities; c) improved supply of services; and, 4) nutrition supplements for pregnant and lactating mothers and young children. The basic package of primary health care services includes family planning, prenatal care, vaccinations, prevention and treatment of diarrheal disease in the home, prevention and control of tuberculosis and respiratory infections, accident prevention, and growth monitoring.

A crucial feature of the program is emphasis on regular visits to health centers. Upon registration with a public health clinic, beneficiaries are given an appointment booklet containing a schedule of visits for each household member. This information is recorded on a form used by the beneficiary as proof of fulfillment of the conditions to receive cash grants for food, which average 125 pesos per month. Beneficiaries also are requested to attend health clinics and nutrition talks at the clinic. Every two months, the health facility verifies household compliance with the number of scheduled visits, and this triggers the transfer of the bimonthly food support to the household. If a single scheduled visit is missed, the household is considered noncompliant.

Health Services: All public sector health institutions in the treatment areas provided the basic package of services. The program ensured adequate supply of medicines, materials, and equipment; encouraged staff to remain working in rural areas; and, provided extra training.

Cash Transfer Mechanism: There was substantial variation in monthly cash transfer received by households as a result of the accompanying education transfer. The average monthly transfer was 197 pesos, which amounts to nearly 20% of household expenditures. On average, households received 99 pesos per month for food support, with the remaining amount for schooling.

Cost: The total annual budget of *Oportunidades* has increased over time as new beneficiaries have been enrolled in the program. In 2000, the budget was US\$998 million, rising to US\$2.3 billion by 2003. On a per capita basis, the program was estimated to be approximately \$44.

Sources: Based on Skoufias, 2005; and Caldés, et al., 2006.

The *RPS* Program in Nicaragua

The *RPS* began in Nicaragua as a pilot program in rural areas in late 2000. Box 2 describes the program in greater detail. The Nicaraguan government designed a randomized experiment to evaluate the effect of *RPS* by randomly assigning 42 eligible communities to either treatment or control areas. Eligible households in treatment areas received conditional transfers beginning in November 2000, and control areas were incorporated into the program approximately two and a half years later. The delay in implementation in control areas was justified as *RPS* was a pilot program requiring evaluation and lacked the administrative capacity to begin operations in all the designated areas at once. The average total *RPS* transfer per family was slightly smaller than than in Mexico, approximately 17% of total annual household expenditures before the start of the program (Caldés et al., 2005). Cash transfers were provided to eligible families every other month.

Annual household panel data were collected in the *RPS* treatment and control areas for the purpose of evaluation. The baseline household survey took place in late August and early September 2000, before the start of the program, and two follow-up surveys were implemented in October 2001 (12 months PBL) and 2002 (24 months PBL). Vaccination data were collected in all three rounds of the survey. As in Mexico, community surveys were carried out during the evaluation and are used as a source of health clinic data for this study.

The health component of *RPS* started in May 2001, and focused on a package of well-baby care and health education. The follow-up surveys provide information that can be used to estimate the impact of the program on vaccination coverage at approximately 5 and 17 months after the start of the program's health component. The first PBL measurement represents the effect of operations for a period similar in length to the first PBL for Mexico, but the second PBL measurement captures the effect over a longer period.

In Nicaragua, the household surveys did not include all beneficiaries in the experimental areas. Instead, using the *RPS* population census, 42 households were randomly selected in each of the 42 areas, yielding an initial target sample of 1,764 households. Overall, 90% (1,581) of the random sample were interviewed in the first round with slightly lower completion in control areas.

Over the three rounds of the survey, there are a total of 2,229 observations of children under the age of three in any of the surveys. The sample is divided fairly evenly between treatment and control areas, although there are approximately 2% more children under three years of age in the control areas.

Box 2: The *Red de Protección Social (RPS)* Program in Nicaragua

Objective: Modeled after *Oportunidades*, the purpose of *RPS* is to address both current and future poverty via cash transfers targeted to poor households conditional on visits to preventive health care providers and school attendance. The program aims to supplement household income for up to three years to increase food expenditures; reduce primary school drop-out rates; and, increase the health care and nutritional status of children less than five years of age.

Coverage: The pilot phase during 2000 and 2001 was implemented in two departments of Nicaragua covering 20,000 households. The second phase began in 2002 and involved an additional 15,000 households.

Health and Nutrition Component: Each eligible household received a bi-monthly cash transfer, contingent on bringing children for scheduled well child health care appointments, attendance at educational workshops, and sending their older children to school. The required health and nutrition services visits included growth monitoring; well baby care; vaccinations; supplementation for anemia; and provision of anti-parasite medicine. Children less than two years of age were seen monthly and those over two were seen every other month.

Health Services: Due to weaker public health capacity in the program areas, *RPS* contracted and trained private health providers, including NGOs, to deliver health care services. Beneficiaries were required to use these contracted service providers. Providers visited program areas on pre-planned dates and delivered services in existing health care clinics, community centers, or private homes. As a result, travel distance for program beneficiaries was reduced.

Cash Transfers: The food security transfer amounted to US\$224 per household per year. In addition, eligible and compliant households could receive US\$112 per year for school attendance, and US\$21 per year per student for school supplies. The food security transfer represented approximately 13% of household expenditures. The average actual monetary transfer was \$272 per household or 17% of household expenditures. The nominal amount of the transfers remained constant over time.

Cost: The *RPS* budget increased over time due to expansion from the initial pilot phase. In 2002, the annual budget was just under US\$5 million, representing 0.02% of GDP. The per capita cost was estimated at approximately \$67.

Adapted from Maluccio and Flores, 2005; and Caldés, et al., 2006.

PART III – METHODS AND EMPIRICAL MODEL

The objective of this analysis is to identify the average treatment effect of *Oportunidades* and *RPS* on vaccination coverage. In theory, immunization coverage rates during the program would be compared with the counterfactual i.e., with the situation that would have occurred without the program. Since this counterfactual cannot be observed, it is estimated through the use of control groups. Both programs employed random assignment to create a control group as the counterfactual. The advantage of using randomization is that, when it is successful, treated and control areas will have the same observed and unobserved characteristics, on average, which removes selection bias regarding the choice of the counterfactual (control) group.

Information on vaccination coverage for BCG, DPT, OPV and MCV was collected in the household surveys for each child under the age of five years for both the *Oportunidades* and *RPS* programs, except for the last follow-up survey for *Oportunidades* which was for children under age three. The study evaluates whether a child was vaccinated by the appropriate age for BCG, MCV, OPV and DPT (the latter two for Nicaragua only).⁹ Children were grouped into the following age intervals for analysis: <12 months, 12–23 months, and 24–35 months. A binary dependent variable was created that takes on the value of one if a child received all the recommended doses of a specific vaccine by the time of the survey, and zero otherwise.¹⁰

Table 4: Vaccination Schedule for Mexico and Nicaragua CCT Programs

Vaccine	Doses Required	Age Given
BCG ¹¹	1	At birth
OPV	3	2,4, and 6 months
DPT	3	2,4, and 6 months
DPT-HepB-Hib (pentavalent) ¹²	3	2,4, and 6 months
MCV (Measles and/or MMR)	1	12 months

Source: Ministries of Health in Mexico and Nicaragua.

As shown in Table 4, BCG vaccinations should be given at birth, and vaccination rates for BCG for children less than 12 months of age will be used as the population group for measuring on-time vaccination. For MCV, OPV and DPT vaccination, the 12–23 month

⁹ Due to data collection problems, data for DPT and OPV were unreliable for Mexico and were not used in this analysis. See Annex 2 for more details.

¹⁰ Partial vaccination obtains a value of zero in this analysis, so that a child receiving the first and/or second doses of OPV or DPT is counted as not being fully immunized for that particular vaccine. While some protective effect is conferred to a partially immunized child, disaggregated analysis was not possible for Mexico because of data limitations. In any case, the primary objective was to examine the effects of CCTs on full vaccination.

¹¹ BCG vaccine provides protection against tuberculosis.

¹² Participants should have received either 3 doses of DPT or 3 doses of pentavalent vaccine to be counted as immunized against diphtheria, pertussis, and tetanus.

age group will be used to explore on-time vaccination because MCV vaccination is scheduled to be given at 12 months of age, and a large proportion of children under 12 months of age will not have received all three doses of OPV or DPT (which is called OPV3 and DPT3).

Lastly, we examine whether the CCT programs were effective in helping older children “catch up” on their vaccination requirements. For BCG, the catch-up groups are those children aged 12–23 months and for all the other vaccines, children aged 24–35 months.

Empirical Specification

In this analysis, we separately estimate the intent-to-treat effect on vaccination coverage for different age groups using an OLS model.¹³ This is done using the double-difference estimator to estimate average program impact. The basic method is shown in Table 5. The columns distinguish between groups with and without the program (denoted by I for intervention and C for control), and the rows distinguish between before and after program implementation (denoted by subscripts 0 and 1). So I_1 , I_0 , C_1 , C_0 represent the mean of the outcome variable for the particular group and time period. Anticipating one of the analyses presented below, consider the measurement of vaccination coverage for MCV among 12–23 month old children. Before the program, one would expect the average percentage vaccinated to be similar for the two groups, so that the quantity $(I_0 - C_0)$ would be close to zero. After the program has been implemented, however, one would expect differences between the groups as a result of the program. Furthermore, because of the random assignment, one would expect the difference $(I_1 - C_1)$ to measure the effect directly attributable to the program. Indeed, $(I_1 - C_1)$ is a valid measure of the average program effect under this design. A more robust measure of the effect, however, would account for any pre-existing observable or unobservable differences between the two randomly assigned groups: this is the double-difference estimate obtained by subtracting the preexisting differences between the groups, $(I_0 - C_0)$, from the difference after the program has been implemented, $(I_1 - C_1)$.

Therefore the double-difference estimator compares the change in the mean coverage rates for a specific vaccine in the treatment group before and after the intervention, to the change in mean coverage rates in the control group over the same period. By comparing changes, the estimator controls for characteristics that do not change over time within treatment and control groups, as well as characteristics that do change over time, but in the same way in each of the two groups. The change in the control group is an estimate of the true counterfactual i.e., what would have happened to the treatment group if *Oportunidades* or the *RPS* program had not been implemented.

¹³ Non-linear models such as probits or logits that use maximum likelihood methods are often employed when the dependent variable is binary. Since vaccination rates are close to or equal to one for certain sub-groups, these models provide unreliable estimates because the probability is perfectly or almost perfectly predicted. Also, observations are dropped if a certain sub-group is completely vaccinated. For these reasons, we use a linear probability model (OLS) and adjust standard errors for the heteroskedasticity inherent in these models. Where possible, we have compared results with logit and probit models and do not find substantive changes in the results.

Table 5: Calculation of the Double-Difference Estimate of Average Program Effect

Survey Round	Treatment Group With Program	Control Group Without Program	Difference Across Groups
Baseline	I_0	C_0	$I_0 - C_0$
Follow-up	I_1	C_1	$I_1 - C_1$
Difference across time	$I_1 - I_0$	$C_1 - C_0$	Double-difference ($I_1 - C_1$) - ($I_0 - C_0$)

Note: I_1, I_0, C_1, C_0 represent the mean of the outcome variable for the particular group and time period.

For this work, the double-difference technique described above is extended to account for three measurement periods. The general regression equation is:

$$V_{ihvt} = \alpha_1 PBL1_t + \alpha_2 PBL2_t + \beta T_v + \delta_1 T_v * PBL1_t + \delta_2 T_v * PBL2_t + X\lambda + \varepsilon_{ihvt} \quad (1)$$

where:

V_{ihvt} = 1 if child i in household h from village v in time period t is vaccinated and zero if otherwise;

α_t = with $t=1,2$ time fixed effects for each of the follow-up surveys;

T_v = 1 if child i is from a treatment village and zero otherwise;

$PBL1_t$ = 1 if 6 months PBL in *Oportunidades* (12 months in *RPS*) and 0 otherwise;

$PBL2_t$ = 1 if 12 months PBL in *Oportunidades* (24 months in *RPS*) and 0 otherwise;

X = baseline socio-economic characteristics of child, household, health clinic, and personnel characteristics; and

ε_{ihvt} = error term

Time fixed effects, α_t , were included to control for unobservable, time-varying factors that are common to both control and treatment areas. A program dummy variable, T_v , was incorporated to account for any pre-existing differences in mean vaccination rates between the treatment and control groups at baseline.

The parameters of interest are δ_1 and δ_2 : δ_1 is the double-difference estimator of the average program effect on vaccination coverage 6 and 12 months PBL for *Oportunidades* and *RPS*, respectively; δ_2 is the double-difference estimator for 12 and 24 months PBL for *Oportunidades* and *RPS*. Since we do not condition on actual program participation but on whether the household lived in a treatment or control area, these are what are commonly referred to as “intent-to-treat” estimates. The randomization of T_v means that T_v (and any interactions involving T_v) should be uncorrelated with all observed or unobserved variables at individual, household, or community level, so that the δ s are consistently estimated with or without other variables included in the regression. The inclusion of other variables in the regression would provide an additional check on the success of the randomization and might increase the precision and consistency of the estimates—an important consideration given the small sample sizes, particularly for *RPS*.

However, given that the randomization was successful, it is not necessary to include other variables in this regression.

The analyses are carried out for Mexico and Nicaragua using municipality-level fixed effects rather than community-level effects. Given the small sample sizes at the community level, there is not enough within community variation to permit precise estimation when community-fixed effects are included in the analysis. This lack of variation arises because there are relatively few children of the appropriate age in the survey within each community.

In the analyses, we include observations on children that have completed their vaccinations in any of the survey rounds (thus using an unbalanced panel). Since heteroskedasticity is present in a linear probability model and there is possible spatial and temporal correlation among the error terms, standard errors are clustered at the village level.¹⁴

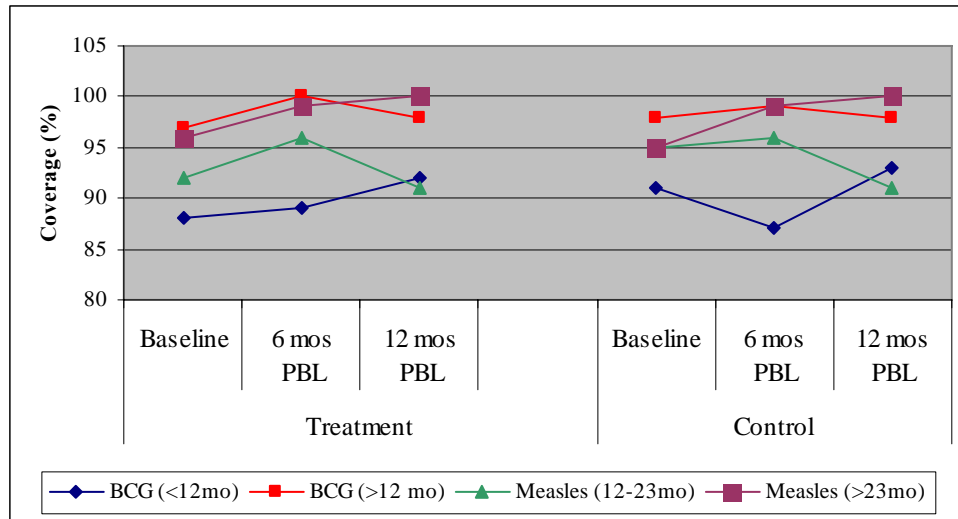
¹⁴ Spatially and temporally correlated errors may be present due to the nature of the cluster sample panel data.

PART IV – RESULTS

Overall Results For Mexico

Figure 4 below presents mean vaccination rates by survey, age group and vaccination type in Mexico. The graph provides a visual representation of the numbers presented in Table 6. The figure illustrates the high coverage levels for BCG and MCV in Mexico as measured in the baseline survey in May 1998 in both the treatment (left-hand side) and control areas (right-hand side). BCG administered to children less than 12 months of age (on-time coverage) increases from 88% to 92% in the treatment areas, and from 91% to 93% in the control areas. Coverage rates for children aged 12–23 months (catch-up coverage) were almost 100% by 12 months PBL in both treatment and control areas. Baseline data for on-time BCG vaccination indicates that differences in vaccination rates existed between treatment and control groups prior to start of the program. For this reason, it is important to use a double-difference estimator which accounts for differences at baseline.

Figure 4: On-Time and Catch-Up Coverage Rates for *Oportunidades* in Treatment and Control Areas by Survey Round



On-time coverage rates for MCVs were also lower in treatment than control areas at baseline (92% compared to 95%). While the percent covered for both treatment and control areas increased between baseline and 6 months PBL, they declined to 91% by 12 months PBL (below baseline levels) in both areas. These data suggest some impact of the CCT program on on-time coverage rates, given that the drop in rates between baseline and 12 months PBL was less in treatment than control areas. The reason for the decrease in coverage rates is unclear. However, for those children aged 24–35 months, coverage for MCV reached 100% in both treatment and control areas 12 months PBL. The rate increases were similar between both groups showing there was no effect of the program on catch-up for this group.

On-Time Effects

Table 6 illustrates the program impact, presenting the double-difference estimates based on the regression specified in Equation 1 along with the statistical significance of the estimates. The estimates control for age (in months) and sex of the child (dummy variable); parental age and years of completed education; the logarithm of per capita household expenditures; a composite indicator of wealth based on other household characteristics; community-level characteristics; and municipality-level fixed effects.

For BCG vaccination in children less than 12 months of age, there was a statistically significant difference in vaccination rates (by 5 percentage points) between the children in the treatment and control groups 6 months after the baseline survey. However, the impact is due to a decrease in coverage rates in control areas rather than an increase in treatment areas. This difference becomes insignificant, declining to 1.4 percentage points, 12 months PBL due to a large increase in coverage rates in the control areas.

Table 6: Vaccination Coverage and Program Impact by Treatment Status, Oportunidades, Mexico

Year	Treatment Area			Control Area			Single Difference			Double Difference	
	Mean	SE	Obs	Mean	SE	Obs	Diff.	SE	T-Stat	Diff.	SE
BCG											
<i>< 12 months</i>											
Baseline	0.88	(0.013)	1320	0.91	(0.013)	788	-0.03	(0.018)	-1.71		
6 months PBL	0.89	(0.010)	1312	0.87	(0.015)	737	0.02	(0.018)	1.16	0.051**	(0.026)
12 months PBL	0.92	(0.010)	952	0.93	(0.013)	592	-0.02	(0.016)	-0.94	0.014	(0.025)
<i>12-23 months</i>											
Baseline	0.97	(0.005)	1397	0.98	(0.006)	850	-0.01	(0.008)	-1.05		
6 months PBL	1.00	(0.001)	1615	0.99	(0.002)	981	0.00	(0.003)	1.02		
12 months PBL	0.98	(0.003)	1354	0.98	(0.004)	821	0.00	(0.006)	0.18		
MCV											
<i>12-23 months</i>											
Baseline	0.92	(0.009)	1383	0.95	(0.009)	841	-0.03	(0.013)	-2.27		
6 months PBL	0.96	(0.005)	1543	0.96	(0.007)	935	0.00	(0.009)	0.17	0.032**	(0.016)
12 months PBL	0.91	(0.009)	1299	0.91	(0.010)	790	0.00	(0.014)	-0.07	0.029	(0.018)
<i>24-35 months</i>											
Baseline	0.96	(0.009)	751	0.95	(0.012)	481	0.01	(0.015)	0.72		
6 months PBL	0.99	(0.003)	1753	0.99	(0.002)	1078	-0.01	(0.004)	-1.61		
12 months PBL	1.00	(0.002)	1425	1.00	(0.002)	840	0.00	(0.003)	-0.96		

Notes: The standard errors (SE) are clustered at the locality level; Individual, household, and community variables, and municipality-fixed are included in the controls in the double difference estimates; Obs = observations, T-Stat = t-statistics, Diff. = difference, SE=Standard error ; * indicates significant at the 10 percent level, ** 5 percent level, and *** 1 percent level.

For MCV in children 12–23 months, the double-difference estimation reveals a statistically significant difference of 3 percentage points between the treatment and the control groups 6 months PBL. Since coverage rates 12 months PBL are lower than baseline levels for both treatment and control areas, the 3 percentage point difference becomes insignificant 12 months PBL as coverage levels drop to 91% in both the treatment and control areas. Despite the lack of significant results 12 months PBL. The program did lead to an equalization of vaccination rates between the treatment and

control group, despite the treatment group's coverage rate being 3 percentage points lower than in the control area at baseline.

Catch-Up Effects

For older children, there is limited room for the Mexican CCT program to have an effect on catch-up vaccination, since starting coverage rates were 90% or greater for BCG (in children 12–23 months) and MCV (in children older than 24 months.) The double-difference estimator may reflect differences at baseline between treatment and control areas, and would be unreliable. For this reason, estimates are not reported.

Sub-Group Effects For Mexico

Household and community level factors may influence household decisions to seek immunization services, and it is therefore possible that certain types of households (or areas with particular characteristics) may have derived greater benefits from the *Oportunidades* program. The differential impact of the program on sub-groups of the population was evaluated using baseline household and community characteristics. In particular, households were classified by household per capita expenditures;¹⁵ whether a mother had any primary education; the presence or absence of a health care facility¹⁶ in the program area; distance from the population center of the program area to the nearest health care facility;¹⁷ the sex of the child immunized; and whether the household head self-identified as being from an indigenous group. Results are presented in Table 7 for on-time vaccinations for MCV. There is no evidence of sub-group differences for BCG vaccination or for the catch-up age groups, so these results are not presented.

For children with less educated mothers, MCV coverage in the control area is 4 percentage points higher than in the CCT area at baseline (95% compared to 91%). Six months PBL, vaccination rates are the same in treatment and control areas (96%), and decline in parallel to 91% 12 months PBL. By 12 months PBL, the program effect (double-difference estimator) is significant and represents a five percentage point increase in MCV vaccination coverage for children in less educated households. For children living in households at least 5.5 km¹⁸ from a health facility, the CCT program is associated with a statistically significant five percentage point increase in MCV vaccination coverage 6 and 12 months PBL.

The results show that the program significantly contributed to equalizing MCV coverage rates between treatment and control groups in these two sub-samples and demonstrate the

¹⁵ Household expenditure is used as a proxy for income and is measured at baseline.

¹⁶ A health care facility could be a health clinic, mobile clinic, hospital, or a place to visit a doctor.

¹⁷ The distance is the approximate distance in kilometers if one were to walk from the center of the most populous community or residential area in the locality to the nearest health clinic.

¹⁸ This is the mean distance to a health care facility in the data set.

role CCT programs can play in raising coverage and improving health status of more vulnerable population groups.

Table 7: Program Effect by Sub-group for On-Time Vaccination Coverage for MCV, Mexico

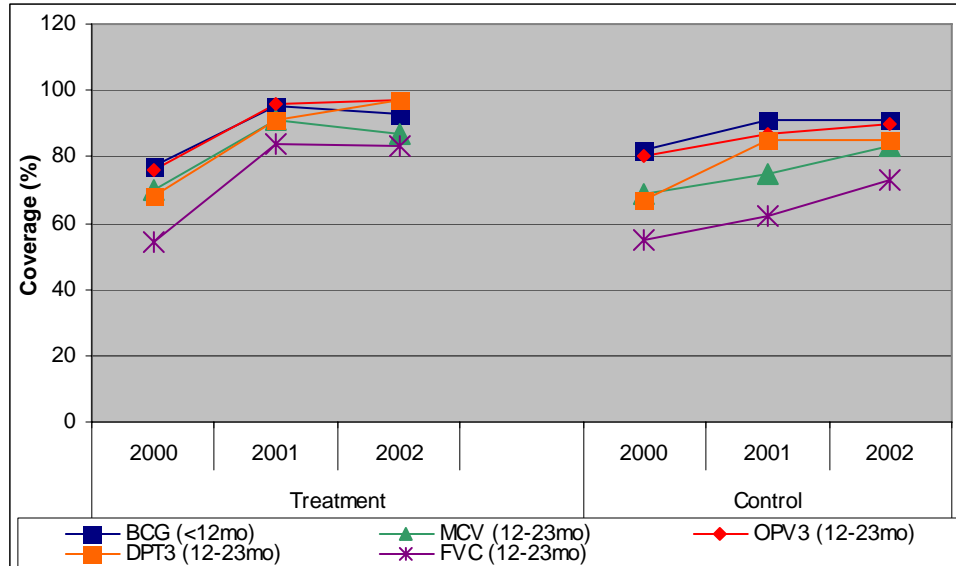
	Treatment Area			Control Area			Double Difference	
	Mean	SE	Obs	Mean	SE	Obs	Diff.	SE
<i>Mother has less than primary school education</i>								
Baseline	0.91	(0.012)	989	0.95	(0.011)	588		
6 months PBL	0.96	(0.007)	1123	0.96	(0.007)	685	0.027	(0.020)
12 months PBL	0.91	(0.010)	957	0.90	(0.012)	574	0.049**	(0.022)
<i>Distance to permanent health clinic is at least 5.5 km</i>								
Baseline	0.90	(0.013)	711	0.95	(0.011)	415		
6 months PBL	0.96	(0.008)	780	0.95	(0.011)	444	0.053***	(0.020)
12 months PBL	0.91	(0.012)	689	0.90	(0.018)	364	0.054*	(0.028)

Notes: The standard errors (SE) are clustered at the locality level; Individual, household, and community variables, and municipality-fixed are included in the controls in the double difference estimates; Obs = observations, T-Stat = t-statistics, Diff. = difference, SE=Standard error ; * indicates significant at the 10 percent level, ** 5 percent level, and *** 1 percent level.

Overall Results for Nicaragua

Figure 5 illustrates substantial increases in coverage levels in both treatment and control areas in Nicaragua over the study period for on-time vaccinations for each vaccine type. The graph provides a visual representation of the numbers presented in Table 8. In treatment areas, coverage rates for fully vaccinated children (FVC) and MCV rose substantially after two years of RPS operation, from 54% to 83% and 70% to 87% respectively for children 12–23 months of age. For OPV3 and DPT3, the results were similar and rates reach close to 100%. OPV3 rose from 76% to 97% , while DPT3 rose from 68% to 97%. Control areas also experienced an increase in vaccination coverage during this time period. Using on-time FVC as a summary indicator, the data show that while both treatment and control areas had similar baseline levels of vaccination coverage (54% and 55%), the program had an positive impact as rates were higher in treatment areas 2 years after the baseline at 83% as compared to 73% in control areas. This simple comparison of means, however, does not indicate whether this impact is statistically significant.

Figure 5: On-Time Coverage Rates for RPS for Treatment and Control Areas by Survey Round



On-Time Effects

Double-difference estimation, as presented in equation (1) was used to estimate the impact of the *RPS* program on vaccination coverage and determine its statistical significance. At 12 months PBL, Table 8 shows that for on-time vaccinations, the double-difference estimates were 7 percentage points for BCG, 12 percentage points for MCV, 13 percentage points for OPV3, 3 percentage points for DPT3, and 20 percentage points for a FVC. Average program impacts were statistically significant at the 10% level (or below) for OPV3 and FVC.

Program effects significant 12 month PBL, however, were no longer significant 24 months PBL, with the exception of OPV3, which showed a significant 13 percentage point increase. This trend may be related to increasing coverage rates in control areas resulting in smaller impacts for some vaccinations, as well as sample sizes that are too small to detect differences. Despite the lack of significance, the program added a 5 to 14 percentage point increase in coverage rates by 24 months PBL for all vaccines. In addition, the program had its greatest effect on vaccines for which it was more challenging to attain high coverage rates since they require multiple doses.

It is important to note that there was a decline in program effects for MCV between the first and second survey rounds: 12 percentage points reduced to 5 percentage points. This drop is related to a reduction in MCV coverage in treatment areas from 91% to 87%, and a simultaneous increase in MCV coverage from 75% to 83% in control areas. It is unknown why there was a drop in the MCV rate over this time period for the treatment

group. Potential reasons for declines in coverage rates over time in general are discussed in the discussion section.

Catch-Up Effects

Table 8 also shows that, with the exception of MCV, the impact of the program on the catch-up group was similar between the two survey rounds. The double-difference estimator on BCG was marginal and insignificant at 12 and 24 months PBL due to increased coverage in control areas and high initial coverage rates in treatment areas. Results for OPV3 and DPT3 showed an impact of 8 percentage points but the effects were not statistically significant.

Between the two survey periods, the pattern program effects for FVC are similar to those for MCV. The program impact increases from an insignificant 6.5 percentage points 12 months PBL, to a statistically significant 16 percentage points 24 months PBL. Given an initial coverage rate of 68% in treatment areas, the program impact at 24 months PBL represents a 24% increase in full vaccination coverage.

Table 8: Main Program Impact by Treatment Status, Nicaragua

Year	Treatment Area			Control Area			Single Difference			Double Difference	
	Mean	SE	Obs	Mean	SE	Obs	Diff.	SE	T-Stat	Diff.	SE
BCG											
<i><12 months</i>											
Baseline	0.77	(0.058)	125	0.82	(0.045)	130	-0.06	(0.073)	-0.75		
12 months PBL	0.95	(0.018)	111	0.91	(0.028)	123	0.04	(0.033)	1.06	0.070	(0.075)
24 months PBL	0.93	(0.026)	76	0.91	(0.022)	89	0.02	(0.034)	0.70	0.052	(0.077)
<i>12-23 months</i>											
Baseline (2000)	0.95	(0.020)	164	0.93	(0.022)	142	0.02	(0.030)	0.73		
12 months PBL	0.99	(0.009)	116	0.96	(0.018)	121	0.03	(0.020)	1.67	-0.008	(0.036)
24 months PBL	1.00	(0.000)	92	0.97	(0.019)	124	0.03	(0.019)	1.74	0.010	(0.040)
MCV											
<i>12-23 months</i>											
Baseline	0.70	(0.051)	164	0.69	(0.055)	142	0.01	(0.075)	0.15		
12 months PBL	0.91	(0.029)	116	0.75	(0.050)	121	0.16	(0.058)	2.80	0.12	(0.087)
24 months PBL	0.87	(0.038)	92	0.83	(0.032)	124	0.04	(0.049)	0.79	0.045	(0.082)
<i>24-35 months</i>											
Baseline	0.85	(0.040)	146	0.86	(0.036)	155	-0.01	(0.054)	-0.16		
12 months PBL	0.94	(0.018)	150	0.95	(0.017)	130	-0.01	(0.025)	-0.25	0.008	(0.053)
24 months PBL	0.98	(0.013)	108	0.87	(0.038)	123	0.11	(0.040)	2.78	0.108*	(0.059)
OPV3											
<i>12-23 months</i>											
Baseline	0.76	(0.048)	164	0.80	(0.056)	142	-0.05	(0.073)	-0.64		
12 months PBL	0.96	(0.021)	116	0.87	(0.050)	121	0.09	(0.054)	1.65	0.128*	(0.068)
24 months PBL	0.97	(0.018)	92	0.90	(0.029)	124	0.06	(0.035)	1.86	0.131*	(0.077)
<i>24-35 months</i>											
Baseline	0.82	(0.051)	146	0.85	(0.051)	155	-0.02	(0.072)	-0.32		
12 months PBL	0.99	(0.009)	150	0.94	(0.021)	130	0.05	(0.023)	2.12	0.076	(0.060)
24 months PBL	1.00	(0.000)	108	0.93	(0.031)	123	0.07	(0.031)	2.13	0.075	(0.065)

Table 8 (cont'd): Main Program Impact by Treatment Status, Nicaragua

Year	Treatment Area			Control Area			Single Difference			Double Difference	
	Mean	SE	Obs	Mean	SE	Obs	Diff	SE	T-Stat	Diff.	SE
DPT3											
<i>12-23 months</i>											
Baseline	0.68	(0.050)	164	0.67	(0.056)	142	0.01	(0.075)	0.19		
12 months PBL	0.91	(0.026)	116	0.85	(0.048)	121	0.06	(0.055)	1.14	0.03	(0.070)
24 months PBL	0.97	(0.018)	92	0.85	(0.028)	124	0.11	(0.033)	3.36	0.111	(0.077)
<i>24-35 months</i>											
2000	0.75	(0.061)	146	0.75	(0.048)	155	-0.01	(0.077)	-0.11		
12 months PBL	0.98	(0.011)	150	0.91	(0.029)	130	0.07	(0.031)	2.33	0.078	(0.072)
24 months PBL	0.98	(0.013)	108	0.89	(0.029)	123	0.09	(0.031)	2.79	0.075	(0.082)
FVC											
<i>12-23 months</i>											
Baseline	0.54	(0.062)	164	0.55	(0.051)	142	-0.01	(0.080)	-0.16		
12 months PBL	0.84	(0.033)	116	0.62	(0.063)	121	0.22	(0.071)	3.16	0.196**	(0.086)
24 months PBL	0.83	(0.037)	92	0.73	(0.042)	124	0.10	(0.056)	1.80	0.135	(0.089)
<i>24-35 months</i>											
Baseline	0.68	(0.064)	146	0.66	(0.053)	155	0.01	(0.083)	0.16		
12 months PBL	0.91	(0.023)	150	0.83	(0.038)	130	0.08	(0.045)	1.70	0.065	(0.092)
24 months PBL	0.96	(0.018)	108	0.77	(0.049)	123	0.19	(0.053)	3.63	0.159*	(0.086)

Notes: The standard errors (SE) are clustered at the locality level; Individual, household, and community variables, and municipality-fixed are included in the controls in the double difference estimates; Obs = observations, T-Stat = t-statistics, Diff. = difference, SE=Standard error ; * indicates significant at the 10 percent level, ** 5 percent level, and *** 1 percent level.

Sub-Group Effects For Nicaragua

As in Mexico, program effects are larger and differ in Nicaragua with respect to distance from a health facility (Table 9) and by mother's level of education (Table 10). In each of the tables, only vaccinations for which there were some significant results are presented. Double-difference estimates for on-time vaccinations for children living more than 5 km from a health clinic¹⁹ show substantial program effects 12 months PBL: a statistically significant 25 percentage points for OPV3; 15 percentage points for DPT3; and 37 percentage points for FVC. The results for FVC illustrate that *RPS* is associated with a 100% increase in the percentage of children 12–23 months fully vaccinated, from an initial rate of 38% in treatment areas.

The previous results are obtained 12 months PBL but only five months after the health part of the program was implemented. Program effects are still large and significant 24 months PBL for OPV3 (28 percentage points), DPT3 (36 percentage points), and FVC (35 percentage points). The results for FVC represent a 92% increase over initial levels in vaccination coverage as a result of *RPS*. In addition, the program appears to have had an equalizing effect between children living near or far from a permanent health facility. This result is illustrated by comparing baseline and 24 month PBL FVC rates for the full sample in Table 8 (0.54 and 0.83) to those children who live far from a health care clinic in Table 9 (0.38 and 0.80).

At 12 months PBL, the findings for catch-up vaccination are similar to those for on-time vaccination. Program impacts are statistically significant and large. In particular, they are 23 percentage points for OPV3, 28 percentage points for DPT3, and 26 percentage points for FVC. These effects grow for each vaccine type by 24 months PBL, and now become significant also for MCV coverage (28 percentage points). The large increase in the impact for MCV is related to declines in vaccination rates in the control group between 12 and 24 months PBL. Using FVC as a summary indicator, the *RPS* program led to an 82% increase in vaccination coverage between the baseline and 24 month PBL and a program impact of 43 percentage points.

Lastly, the program effects for children whose mothers have less than primary school education are only significant for the catch-up group. Table 10 demonstrates there were statistically significant findings for MCV (16 percentage points) and FVC (21 percentage points) at 24 months PBL.²⁰ The latter result represents a 32% increase in FVC among older children. Similarly to distance to a health care clinic, comparison of rates between the full sample (Table 8) and those for mothers with less than primary school education (Table 10) illustrate that coverage rates were largely equalized between children living with more or less educated mothers.

¹⁹ This is the mean distance to a health care facility in the data set. Results for those located closer to health care facilities are not presented as there are no statistically significant program impacts.

²⁰ The results for BCG and on-time vaccinations are not presented as they are not statistically significant.

Table 9: Program Effect of Distance to Permanent Health Facility at Least 5km on On-Time and Catch-up Vaccinations, Nicaragua²¹

Year	Treatment Area			Control Area			Double Difference	
	Mean	SE	Obs	Mean	SE	Obs	Diff.	SE
MCV								
<i>12-23 months</i>								
Baseline	0.59	(0.069)	79	0.60	(0.094)	50		
12 months PBL	0.85	(0.049)	60	0.65	(0.075)	48	0.208	(0.140)
24 months PBL	0.85	(0.047)	46	0.80	(0.069)	35	0.132	(0.158)
<i>24-35 months</i>								
Baseline	0.77	(0.058)	79	0.92	(0.032)	53		
12 months PBL	0.93	(0.023)	80	0.95	(0.029)	44	0.111	(0.078)
24 months PBL	0.96	(0.025)	57	0.83	(0.046)	41	0.284***	(0.091)
OPV3								
<i>12-23 months</i>								
Baseline	0.63	(0.050)	79	0.72	(0.118)	50		
12 months PBL	0.95	(0.036)	60	0.77	(0.083)	48	0.245**	(0.096)
24 months PBL	0.96	(0.029)	46	0.83	(0.053)	35	0.278*	(0.144)
<i>24-35 months</i>								
Baseline	0.72	(0.077)	79	0.91	(0.047)	53		
12 months PBL	0.99	(0.012)	80	0.91	(0.034)	44	0.233***	(0.084)
24 months PBL	1.00	(0.000)	57	0.90	(0.050)	41	0.258**	(0.111)
DPT3								
<i>12-23 months</i>								
Baseline	0.58	(0.065)	79	0.64	(0.106)	50		
12 months PBL	0.87	(0.046)	60	0.75	(0.077)	48	0.150**	(0.072)
24 months PBL	0.96	(0.029)	46	0.74	(0.047)	35	0.358***	(0.109)
<i>24-35 months</i>								
Baseline	0.59	(0.078)	79	0.79	(0.075)	53		
12 months PBL	0.96	(0.018)	80	0.84	(0.047)	44	0.277**	(0.111)
24 months PBL	0.96	(0.024)	57	0.80	(0.040)	41	0.329***	(0.118)
FVC								
<i>12-23 months</i>								
Baseline	0.38	(0.065)	79	0.50	(0.097)	50		
12 months PBL	0.75	(0.046)	60	0.46	(0.082)	48	0.370***	(0.083)
24 months PBL	0.80	(0.041)	46	0.66	(0.074)	35	0.345**	(0.135)
<i>24-35 months</i>								
Baseline	0.51	(0.071)	79	0.70	(0.101)	53		
12 months PBL	0.89	(0.030)	80	0.77	(0.056)	44	0.263**	(0.129)
24 months PBL	0.93	(0.032)	57	0.66	(0.064)	41	0.430***	(0.133)

Notes: The standard errors (SE) are clustered at the locality level; Individual, household, and community variables, and municipality-fixed are included in the controls in the double difference estimates; Obs = observations, T-Stat = t-statistics, Diff. = difference, SE=Standard error ; * indicates significant at the 10 percent level, ** 5 percent level, and *** 1 percent level.

²¹ There are no statistically significant sub-group differences for TB, so these results are not reported.

Table 10: Program Effect on Catch-Up if Mother has less than Primary School Education, Nicaragua

Year	Treatment Area			Control Area			Double Difference	
	Mean	SE	Obs	Mean	SE	Obs	Diff.	SE
MCV 24-35 months								
Baseline	0.84	(0.043)	134	0.86	(0.040)	139		
12 months PBL	0.93	(0.020)	135	0.95	(0.018)	109	0.016	(0.055)
24 months PBL	0.99	(0.010)	98	0.86	(0.040)	115	0.155**	(0.063)
OPV3 24-35 months								
Baseline	0.81	(0.056)	134	0.83	(0.057)	139		
12 months PBL	0.99	(0.007)	135	0.93	(0.024)	109	0.076	(0.069)
24 months PBL	1.00	(0.000)	98	0.93	(0.033)	115	0.084	(0.077)
DPT3 24-35 months								
Baseline	0.72	(0.065)	134	0.76	(0.052)	139		
12 months PBL	0.98	(0.012)	135	0.89	(0.033)	109	0.098	(0.077)
24 months PBL	0.98	(0.014)	98	0.89	(0.030)	115	0.103	(0.091)
Full Vaccination Coverage 24-35 months								
Baseline	0.65	(0.068)	134	0.67	(0.058)	139		
12 months PBL	0.90	(0.025)	135	0.82	(0.036)	109	0.103	(0.089)
24 months PBL	0.97	(0.017)	98	0.77	(0.054)	115	0.209**	(0.091)

Notes: The standard errors (SE) are clustered at the locality level; Individual, household, and community variables, and municipality-fixed are included in the controls in the double difference estimates; Obs = observations, T-Stat = t-statistics, Diff. = difference, SE=Standard error ; * indicates significant at the 10 percent level, ** 5 percent level, and *** 1 percent level.

Summary of Study Findings

The main findings are the following:

- Immunization coverage rates fluctuated over time in Mexico and Nicaragua in both treatment and control groups.
- Despite high initial coverage levels in Mexico and coverage rate fluctuations in both countries, we find significant program effects on immunization coverage rates for both Mexico (middle income) and Nicaragua (low income), though not for all time periods or age groups.
- Six months after its introduction, implementation of *Oportunidades* in Mexico was associated with a statistically significant 5 percentage point increase in BCG coverage rates and a 3 percentage point increase in MCV coverage for on-time vaccination. Unfortunately, 12 months after the program, these program effects were no longer statistically significant. Due to high initial levels of coverage there were also no significant effects on catch-up for either vaccine or time period.

- Five months after the introduction of the health component in Nicaragua, the program impact led to a statistically significant increase in on-time vaccinations for OPV3 coverage (13 percentage points or 17 percent) and fully vaccinated children (20 percentage points or 37 percent). While there were large point estimates, there were no statistically significant effects on catch-up during this time period. A year later, the impact of the program on on-time vaccination for OPV3 was still a statistically significant 17 percent increase. There was also a 24 percent increase in FVC coverage for the catch-up group. Despite the lack of significance for some vaccines, the program added a 5 to 14 percentage point increase in on-time coverage rates by 24 months PBL for all vaccines.
- In both countries, the CCT program had large statistically significant effects on immunization coverage rates for children with less access to health services (measured by distance to a health facility) and for those children living in households with less educated mothers. This is highlighted by the results for FVC in Nicaragua. For the on-time and catch-up age groups there was a 92% and 82% increase respectively in vaccination coverage between baseline and 24 months PLB for those who lived further from a health clinic.
- Coverage rates between children living with more or less educated mothers and those living near or far from a health facility appears to have been equalized during the study period.
- While program impacts were positive, the significance of program effects for both countries were mitigated in many cases due to simultaneous increases in immunization coverage in control areas.

PART V – DISCUSSION

Our findings show positive significant program effects of conditional cash transfer programs on vaccination coverage for selected vaccines and specific sub-populations in both Mexico and Nicaragua. Results were particularly large and significant for those groups who lived further from a health facility and whose mothers were less educated.

Immunization coverage rates were above 90% for both BCG and MCV prior to the start of the program in Mexico making it a difficult context within which to significantly improve coverage levels.²² Nevertheless, it is encouraging that *Oportunidades* had a significant effect on population sub-groups that have been historically associated with lower coverage rates. (i.e. those with more difficult access to health clinics and children whose mothers are less educated). This is an important finding, as it shows that CCT programs may be a useful strategy for reaching hard-to-reach populations and for achieving coverage rates required for measles elimination (95% or above).

One reason *RPS* and *Oportunidades* did not have a larger and more significant impact on vaccinations is the substantial increase in vaccination rates in control areas during the study period. Unfortunately, there is no clear explanation for the increase in coverage rates in control areas. It is possible that control group areas heard of the program and there was an anticipation effect. Indeed in Nicaragua, approximately one third of households in the control areas were aware of the features of the *RPS* program. Another possibility is that the control group experienced a contamination effect from the treatment areas in Nicaragua due to the increase in health supply through the NGOs. However, there is no evidence collected in the household survey or other health activities in the community to suggest an increase in NGO activity in control areas.

There may also have been a supply-side spillover effect from the program into control areas. This could have taken several forms. It is also possible that the Ministry of Health strengthened its actions in program municipalities in both Mexico and Nicaragua leading to an increase supply in both treatment and control areas. In Nicaragua, vaccinations were sent from the Ministry of Health directly to municipality health offices, and health care provision (including vaccination) was provided to beneficiaries by private providers new to the areas. Therefore more time and supplies also may have been available to control group participants from the usual governmental health care providers in the area. We believe that, to the extent that there was a supply-side spillover effect in the control areas, the estimated impact on vaccinations would be downward biased, making the results reported here conservative.

That statistical significance was not found for all vaccines is not surprising, given the large sample sizes that are required to detect small program effects.²³ Given the importance of sub-

²² Due to these high vaccination rates, we are unable to examine the success of *Oportunidades* in encouraging older children who missed receiving their vaccinations at the recommended age.

²³ One of the parameters included in the power calculations for the original evaluation design in Nicaragua was an effect size of 10 percentage points on up-to-date vaccination coverage for children 12–23 months old (Maluccio and Flores, 2005). However,

group analysis for detecting effects of CCTS, sample sizes determined in the design stage of an impact evaluation should be adequate to accommodate disaggregated sub-group analysis.

The study period for both Mexico and Nicaragua comprised two survey periods following a baseline survey. While program effects were found during this period, mitigation of these effects over time was seen in both countries. A crucial question that remains to be addressed is whether effects of these programs on vaccination coverage will persist over a longer period of time. Continued evaluation would help us to better understand the sustainability of the changes achieved by *RPS* and *Oportunidades*. Such a result would provide additional insight into policy decisions to implement CCTs for the purpose of raising coverage rates, given the high costs of implementation.

MCV coverage rate declined in treatment areas in both Mexico and Nicaragua in the second post baseline survey. The reason for these declines is unknown but could be due to non-random attrition of children or measurement error.²⁴ Non-random attrition bias seems unlikely, however, since a decrease in coverage levels would be expected for other vaccines as well. Measurement error bias is possible and would be particularly influential because the sample size is small. Still, it is unclear why measurement error would affect the different indicators differently. Lastly, it may be a case of mean reversion.²⁵

For this study, the analysis of *Oportunidades* data was constrained by data quality concerns (see Annex 2). It appears that surveyors may have recorded coverage data incorrectly, and the survey instrument was not appropriately designed for an unbalanced panel. For instance, respondents were asked to provide information on the number of vaccines they had received since the last survey, rather than the total number of vaccines ever received. This created measurement error in the data, particularly for children who joined the survey after the baseline and for vaccines requiring more than one dose for full protection. To avoid problems of data inaccuracy experienced in this study, it is recommended that future panel data questionnaires gather information on the total doses ever received in each survey so that the incremental number of doses received between survey periods can be easily and unequivocally estimated.

While every effort was made to obtain information and data pertaining to delivery of immunization services in Mexico and Nicaragua, it was not possible to control for potential supply side effects, such as frequency of campaigns or vaccine shortages, on immunization coverage rates. Therefore the estimated impacts represent changes in both demand and supply. With vaccination rates greater than 90% since 1992 in Mexico, the vaccination supply is unlikely to be an important constraint, but could have had a larger influence in Nicaragua. Our research design relies on the vaccine supply being constant or changing in the same way between the treatment and controls in order for the results to be unbiased. In future work on CCTs in other countries, it would be useful to collect data on the number of doses delivered and investigate

those calculations did not forecast decreases in sample size from attrition, a problem that could be contributing to the lack of significance.

²⁴ The number of children 12-23 months of age in the treatment group sample declines from 164 at baseline to 92 at 24 months PBL in Nicaragua.

²⁵ It was not possible to use a regression discontinuity design to check for mean reversion because the variation in the data was inadequate given the smaller sample size needed for this design.

whether there were any major fluctuations during the treatment period. Information on when the national campaign days (or weeks) took place would also aid in understanding fluctuations in vaccination rates between surveys.

Very little is known about the mechanism of the effect of CCTs on health-seeking behavior, and whether it is a pure income effect, an empowerment effect, or related to the imposition of conditions. Households could potentially reallocate time and resources to seek health care and by extension, immunization services, as household income rises through a pure cash transfer.

Finally, although this study demonstrates a positive impact of CCTs in a limited geographic area in both a middle- and low-income country, and in countries with both initial high and lower coverage levels, evaluations of other country experiences are required in order to generalize these results more fully.

PART VI – CONCLUSIONS AND POLICY RECOMMENDATIONS

The results of this study suggest that in Mexico and Nicaragua:

- CCTs contribute to increased vaccination coverage among children, particularly among those not reached by traditional program strategies (i.e those who have more difficult access and among mothers with lower education). Program effects are seen in high and low coverage settings, as well as in low- and middle-income countries.
- CCTs need to be considered as one of the possible strategies that national immunization programs can use to strengthen vaccination coverage, particularly among hard-to-reach populations.
- The design of CCTs could be strengthened by targeting health conditions towards sub-groups that traditionally have had limited access to services or are less educated, and by ensuring an adequate monitoring and evaluation framework, such as large sample sizes for assessing sub-group effects.²⁶
- The global immunization community needs to increase its awareness of CCTs and their possible role in achieving MDG4.

These results have implications for national and global immunization policy, as well as for those involved in designing and implementing safety net programs. At the national level, immunization program managers need to become more aware of the benefits of CCT programs on achieving higher coverage levels, particularly among hard-to-reach population groups. Managers need to become more involved in identifying the appropriate immunization-related conditions used in CCTs, and to have input into survey instruments designed to measure changes and impacts. Comparisons between CCT results and national reporting of immunization coverage by district or municipality could be instituted in order to tease out the effects of supply- versus demand-side programs. National governments could be encouraged to pilot demand-side financing strategies, such as CCTs, to achieve immunization goals.

Among global immunization policy makers, there is a lack of awareness regarding conditional cash transfer programs or other types of demand-side financing strategies that could be supported with the large sums of resources being generated for immunization. The IFFIm promises to raise nearly \$4 billion USD to strengthen national programs, but so far, there has been little discussion about the particular demand-side strategies that may effectively help to reach immunization program and MDG targets (Brenzel, 2007). The GAVI Alliance Health Systems Strengthening (HSS) window may be a useful mechanism for financing pilots, although the multisectoral nature of CCTs implies that technical support needs to come from several disciplines, including health.

Among ministries and professionals responsible for the design of safety net programs such as CCTs, there needs to be greater awareness of the programmatic issues related to the specific health conditions. There is also need for better linking with line ministries and departments

²⁶ We understand that there are both monetary and other costs involved in narrower targeting, and that these might outweigh the benefits (e.g. additional program objectives beyond vaccination might not benefit from a narrower targeting strategy).

responsible for these programs, in order to ensure a functioning supply-side and effective demand for services.

While this study demonstrates feasibility of CCTs to reach certain disadvantaged population, there are many areas for further enquiry including:

- To what extent are there neighborhood effects with regard to vaccination coverage and what role do CCTs play in this effect?
- What are the possible pathways by which there are greater coverage effects for low-access and more poorly educated households?
- Are the effects of CCTs sustained when the conditions are no longer part of the program? Has there been a lasting change in health seeking behavior?

Another outstanding issue is whether the costs of implementing CCTs outweigh their benefits in terms of increased vaccination coverage and impact on reducing mortality and morbidity from vaccine-preventable diseases. On average, it costs \$17 to fully immunize a child (Brenzel, et al., 2006), but these estimates are based on current levels of coverage using mainly supply-side delivery strategies. Unit costs of vaccinating additional children are expected to rise, as more resources will be required to identify and deliver services in remote areas. Rough estimates of the per capita costs for CCTs (program and transfer costs) range from \$44 to \$67 for nutrition, health education, schooling, and basic health services (estimated from Caldés, et al., 2005). The cost-effectiveness of achieving greater vaccination coverage through CCTs would be well-worth investigating.

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ANNEX 1 - HEALTH COMPONENTS FOR SELECTED CCT PROGRAMS

Program	Year of Creation	Target Population	Childhood Immunizations	Antenatal Care	Growth Monitoring & Nutritional Development	Health Education	Well-baby/Well-child Care	Necessary Preventive Care/Checkups
<i>Programa Familias, Argentina</i>	2005	Minors and pregnant women	X	X				
<i>Bolsa Alimentação, Brazil</i>	2001	Children 6 months to 6 years; pregnant and lactating women	X		X	X		
<i>Bolsa Familia, Brazil</i>	2003	Children 0 to 6 years; pregnant women	X	X	Follow-up			
<i>Subsidio Unitario Familiar (SUF), Chile</i>	1981	Children 0 to 6 years					X	
<i>Familias en Acción, Colombia</i>	2001	Minor children			X		X	
<i>Solidaridad, Dominican Republic</i>	2005	Children aged 0 to 5 years					X	
<i>Bono de Desarrollo Humano, Ecuador</i>	2003	Children aged 0 to 5	X		X		X	
<i>Red Solidaria, El Salvador</i>	2006	Children less than 5 years, pregnant women ²⁷	X	X	X			
<i>PRAF II, Honduras</i>	2000	Children less than 5 years and pregnant women ²⁸		X	AIN Participation			X

²⁷ The health and nutrition transfer would require that households fulfill the separate co-responsibilities, specifically that: (i) parents assure that all children under 5 are fully immunized under the established health protocols; and (ii) that children under 5, as well as pregnant mothers, participate in regular health and nutrition monitoring, again according to the established health and nutrition protocols.

²⁸ Children aged 0-5: under 2 years old, must have visited the health centre at least once a month; 2 to 5 years old, must have visited the health centre every 3 months. Main beneficiaries must have attended training courses 4 times per year. Pregnant mothers: at least 5 pre-natal checkups. Main beneficiary must have attended training courses at least 4 times per year.

Program	Year of Creation	Target Population	Childhood Immunizations	Antenatal Care	Growth Monitoring & Nutritional Development	Health Education	Well-baby/Well-child Care	Necessary Preventive Care/ Checkups
<i>PATH, Jamaica</i>	2001	Children 0–6 years, pregnant women, elderly, disabled ²⁹						X
<i>Cash Transfer Program for Orphans and Vulnerable Children, Kenya</i>	Pilot, 2004	Children aged 0 to 5 years	X		Includes Vitamin A Supplementation			
<i>Oportunidades, Mexico</i> ³⁰	1997	All household members	X	X	X	X		
<i>Child Money Program (CMP) Mongolia</i>	2005	Children	X					
<i>Red de Protección Social, Nicaragua</i>	2000	Children aged 0 to 5	X		X	X		
<i>Tekoporá, Ñopytyvo and Abrazo Program, Paraguay</i>	2005 (pilot)	Children aged 0 to 5; pregnant women ³¹		Plus Postpartum care	X		X	Including dental care
<i>Juntos, Peru</i>	2005	Pregnant women and children less than 5 years ³²		Postpartum care	Includes iron supplementation and de-worming		X	
<i>Social Risk Mitigation Project, Turkey</i>	2001	Children age 0 to 6 years, pregnant women ³³		Postpartum care			X	

Source: Fishbein, A. and Schady, N. 2006.

²⁹ Required visits to health centre: 1 visit/2 months for children 0-12 months; 1 visit/6 months for children 12-71 months; once every two months for pregnant women, 6 weeks after delivery and two months thereafter; one visit every 6 months for the elderly; one visit every 6 months for persons with disabilities.

³⁰ Formerly *Progres*a.

³¹ Visit to health center for pregnancy checkups and post-partum control for pregnant women; visit to health center for growth/development monitoring for infants aged 0 to 24 months old and children 25 to 60 months old; and attendance at health center for medical checkups and preventative dental care for children 5 to 14 years old.

³² Pregnant women: pre-natal controls (1), post-natal controls (1), full inoculations schedule, Vitamin A, iron and folic acid supplements; attendance at nutritional, reproductive health and food cooking chats. Children up to 5 years old: full inoculations schedule, iron supplement, growth and development monitoring, deworming, and chlorine tablets.

³³ Health follow-up periods are as follows: (i) children at 0 to 6 months require regular check-ups every month; (ii) children of 7 to 18 months require regular check-ups every two months; and (iii) children of 19 to 72 months require regular check-ups every six months. Pregnancy grant - follow-up periods are as follows: (i) regular check-ups are required every month until the birth; (ii) birth shall be given in hospital; and (iii) post-birth check-ups are required following the birth.

ANNEX 2 – DATA ISSUES

The purpose of this annex is to describe in more detail some of the limitations in the data including the issues that precluded double-difference analysis of DPT3 and OPV3 vaccination status in Mexico.

Collection of Vaccination Data

It is unclear from the survey and the survey manuals for both Mexico and Nicaragua if vaccination data were collected on the basis of mother's recall only or using vaccination cards and mother's recall—"card plus history". In each of the surveys in Mexico, at least 95% of all respondents said they had a vaccination card for the child. The two post baseline surveys also indicate if the respondents showed the vaccination card to the enumerator. Of those who had a vaccination card, 18% and 16% of respondents could not present it to the surveyor at 6 and 12 months PBL, respectively. In Nicaragua, 17 percent of households across all survey said they did not have a vaccination card. Unfortunately, it is not possible to determine for each vaccine whether the information came from the mother or the vaccination card. Because it is unknown if a vaccination card was shown to the enumerator at each round of the surveys in Mexico and where the vaccination information for some of the observations in Nicaragua, the analysis does not control or split the sample by source of vaccination data.

Recording Errors in the Mexican Vaccination Data

Careful examination of the Mexico data reveals that some enumerators may not have collected the data correctly. This is likely a result of how the survey instrument was designed across years. The baseline survey (May 1998) asked for information on the total number of doses ever received by children aged five or less for each vaccine type. The October 1998 survey provides data on the number of doses a child aged five and under received for each vaccine in the previous six months (i.e. the period since the last baseline survey). The May 1999 survey also collected data on the number of doses of each vaccine that a child received in the previous six months. Given the information provided below in Table A2.1, it seems likely that some enumerators recorder the number of doses ever received in each round of the survey.

Table A2.1 below displays the total number of cumulative BCG vaccinations received by children as estimated from the survey data. In May 1998, there were no children recorded as receiving more than the one recommended dose of BCG. By the second survey, 60% of children had received 2 doses of the BCG vaccine —more than the recommended number. In the May 1999 survey, 87% of children had received more than one BCG vaccination. It is highly unlikely that such a high proportion of children received more vaccinations than is necessary in follow-up surveys relative to the baseline survey. This is especially surprising since BCG vaccination leaves a scar which is a clear indication of having received the vaccine.

A similar pattern is observed for OPV3, MCV, and DPT3 vaccinations in the Mexico surveys. Table A2.1 presents OPV3 data which shows that in each subsequent survey a larger proportion of children received more than the recommended three doses of vaccine. These figures suggest that rather than collecting doses received between survey rounds at each survey, the cumulative number of doses received by the survey date was recorded.

Table A2.1: Number of Observations by Total Number of Doses for Children 12–23 Months

Total Doses	BCG			OPV3		
	May-98	Oct-98	May-99	May-98	Oct-98	May-99
0	59	31	7	41	11	12
1	2,188	722	115	590	129	51
2		1,146	420	498	377	125
3			410	526	464	184
4				287	378	174
5				184	235	147
6				0	122	85
7				0	59	58
8				0	19	34
9				0	5	16
10				0	1	4
11				0	0	1
13				0	0	1
14				0	0	1
Total Observations	2247	1899	952	2126	1800	893

This data problem contaminates estimation of up-to-date vaccinations for vaccines requiring more than one dose (i.e. DPT and OPV), so the data for these two vaccines were excluded from the Mexico analysis. To understand why the data can not be used accurately, consider a child who received one dose of the OPV before the baseline survey (recorded as 1 in the baseline survey), and another dose between the baseline and first follow-up survey. They did not receive another dose. Therefore, by the end of the third survey the child had a total of two doses of OPV. If the cumulative number of doses was collected by mistake in the follow-up surveys, and this was added to the number received by baseline, the data would indicate that the child was fully vaccinated against OPV3 in the first and second follow-up surveys, which is not the case. As it is not possible to distinguish if the data was collected correctly, the DPT and OPV data are excluded from the analysis in Mexico.³⁴

The total number of vaccinations ever received in Mexico may also be inaccurate due to two data issues in the baseline survey. The first problem concerns the inability to match some children across surveys due to incorrect individual identification numbers.³⁵ The

³⁴ Examination of the surveyor’s manual did not clarify the issue.

³⁵ A child is uniquely identified by a family identification number and an individual identification number. The family identification number is the same for each person in a particular family. Over 3000 children in the baseline were

second data problem arises because 805 children in the baseline had no recorded vaccination data.³⁶

As a result of the two missing data problems outlined above, 1,798 children greater than 11 months of age in the two follow-up surveys could not be matched to the baseline survey. This creates a measurement problem for the dependent variable, since it is not possible to accurately calculate the total number of vaccinations ever received. Remember, after the baseline survey the survey instrument asked for the number of vaccinations received since the last survey, not the total number of vaccinations.

There are two ways to deal with these data problems. One is to code the observations as missing in the baseline, the other is to assume the child had not received a MCV or BCG in the baseline and code them as zeros. Table A2.2 shows that, using the two methods of recoding, the percentage of missing observations is almost the same between the treatment and control groups for all survey rounds. While the two methods of creating the dependent variable lead to different estimates of children vaccinated, the findings remain the same. For this reason and in an effort to increase the sample size, results for recoding to zero are presented in the analysis.³⁷

missing an individual identification number. Since the children had a family identification number, all but 484 children in the baseline could be matched with the subsequent surveys using the family identification number and the age and sex of the child. Unfortunately, the child's name was not available in all of the surveys. This information was needed to correctly match the rest of the children.

³⁶ Of these children 382 were missing the data because the interviews were never completed or did not take place, the rest of the children were not present in the baseline.

³⁷ This assumption may lead to an under-estimate of vaccination levels for the sample in the baseline and follow-up surveys.

Table A2.2: Observations for Alternative Handling of the Dependent Variable by Vaccine Type

	May-98	Total Oct-98	Nov-99	Treatment Group			Control Group		
				May-98	Oct-98	Nov-99	May-98	Oct-98	Nov-99
<i>BCG</i>									
Total observations	6480	9101	7228	3999	5659	4468	2481	3442	2760
Number of missing observations	54	665	360	34	398	221	20	267	139
% missing	1	7	5	1	7	5	1	8	5
Number of missing reset to zero	0	296	152	0	173	94	0	123	58
% not changed	0	45	34	0	43	35	0	46	32
Number of missing after change	54	369	208	34	225	127	20	114	81
% missing after change	1	4	3	1	4	3	1	4	3
<i>MCV</i>									
Total observations	6480	9101	7228	3999	5659	4468	2481	3442	2760
Number of missing observations	195	1937	1665	122	393	246	73	250	154
% missing	3	21	23	3	7	6	3	7	6
Number of missing reset to zero	0	1294	1265	0	798	772	0	496	493
% changed	0	67	69	0	67	68	0	66	70
Number of missing after change	195	643	400	122	393	246	73	250	154
% missing after change	3	7	6	3	7	6	3	7	6

