‘Chasing children’: The impact of rural community-based health services on childhood immunization in Nkwanta District, Ghana

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Summary

This paper presents an evaluation of a rural community-based strategy for health service delivery and its impact on the Expanded Program of Immunization (EPI) coverage in Nkwanta District, Ghana. The EPI program in Ghana is implemented at static health facilities, which requires mothers to keep track of her child's immunization schedule and travel to the provider's facility at the specified time. Starting in 1998, Community-based Health Planning and Services (CHPS) introduced a new model of health service delivery by posting resident nurses in remote rural communities. In the CHPS model, nurses and volunteers travel to villages in their catchment area to provide integrated health care including child immunization by canvassing households door-to-door in addition to close-to-client static health service delivery. Using data collected from a comprehensive 2004 District Evaluation Survey, this analysis finds significant associations between living in a CHPS zone and improved odds for the complete immunization of children aged 12 to 59 months [OR=1.66, p=.017].

Introduction

Childhood mortality and morbidity rates in rural West Africa are among the highest in the world. Although several international initiatives have given priority to routine immunization services and integrated management of childhood illnesses, few programmes have successfully demonstrated sustainable ways of reaching rural communities with comprehensive immunization coverage. In response to this challenge, WHO and UNICEF developed the Expanded Programme of Immunization (EPI) in 1974 as a set of technological standards, as well as a mechanism for health service delivery, management, monitoring and evaluation.[1] The standard EPI immunization schedule for

the sub-Saharan African region stipulates the provision of BCG (tuberculosis) at or near birth, three doses of DPT (diphtheria, pertussis, and tetanus), three doses of the polio vaccine and one dose of the measles vaccine all to be completed before the age of 24 months.[2]

The Ghana Health Service manages the EPI programme through district and regional health teams. Each sub-district public health facility runs a monthly Child Welfare Clinic, where mothers bring their infants and toddlers for postnatal checks, growth monitoring, immunization and vitamin A supplementation. In addition, the staff of each health facility travels to designated health outposts in the sub-district to provide child welfare services on a rotating monthly basis. However, by 1997 it became apparent in Nkwanta District that there were still several remote villages and communities that were not participating in EPI services and district-wide coverage rates mostly remained below 50% (see table 1).

The framework for Community-based Health Planning and Services (CHPS) is based on a system of community mobilization, education, planning and collective action in traditional rural areas. The Ghana Ministry of Health (MOH) adopted CHPS as a new mechanism for national health sector reform in 1999, after which CHPS has become fully operational in 20 districts and is being implemented in 110 out of 138 districts.[3] As the first district to pilot CHPS, Nkwanta District has become the ideal research setting for evaluating CHPS immunization coverage in comparison to the static health facility-based EPI model. According to the Nkwanta District 2004 District Evaluation Survey, 27 percent of female respondents lived in a CHPS-demarcated community, or CHPS zone (a cluster of approximately 7 communities with a total population of about 2,000). Whereas

everyone in Nkwanta is considered to be covered by their sub-district static health center, irregardless of their distance to the nearest facility, CHPS coverage is defined by the distance that the nurse is able to travel by motorbike to reach her clients. Since the entire district is covered by basic EPI services, the immunization coverage rates for the 27% of the sample population exposed to CHPS is defined as the marginal difference that CHPS adds to EPI services. Besides discussing differentials, this paper will also analyze socio-economic determinants of childhood immunization in order to provide specific recommendations for improved rural immunization services.

The purpose of this paper is to 1) identify structural and social barriers that may increase the rural immunization bias; 2) test the hypothesis that the CHPS initiative addresses barriers to rural EPI access and will increase the odds of complete immunization at the individual level; and 3) describe socio-economic determinants of mothers and households that have fully immunized children in an impoverished rural district. Due to data limitations, this analysis will not assess the effect that immunization coverage rates might have had on child morbidity or mortality trends.

Background

A WHO programme evaluation by Bryce, et al. (2005) found that several health systems barriers have hindered implementation of global child survival programmes, such as IMCI. They recommended that child survival programmes should also utilize community-based delivery systems instead of solely focusing on static government health facilities. Likewise, the State of the World's Vaccines and Immunization report (WHO/UNICEF/World Bank, 2003), specifically mentions Ghana's health sector reform

as a successful means for increasing district-level targeted immunization rates by providing close-to-client health services that are better able to reach poor and under-served populations. They further conclude that community-based outreach services could be used as a platform for immunization and other integrated child health services, especially in hard to reach areas that include nomadic populations. For the purposes of equitable national distribution of services, they substantiate the importance of monitoring and evaluating immunization and disease incidence at the district-level.

Complete eradication of the six main preventable childhood diseases, diphtheria, measles, pertussis, poliomyelitis, tetanus, and tuberculosis, will require 90 percent of children in Ghana to be fully inoculated against them by the age of 12 months, and every district to attain at least 80 percent coverage rates (WHO/UNICEF, 2004).[4] Ghana's immunization coverage rates are below internationally set standards, despite slight improvements in the past decade that rank Ghana in the median-range of immunization coverage among developing countries (The World Bank Group, 2005). In 1993, 42.9 percent of children aged 12 to 23 months were fully immunized before they were 12 months olds, which increased to 50.5 percent in 1998 and 58 percent in 2003 (DHS Macro International, 2003).

Whereas the EPI programme in Ghana has attained relatively high coverage rates for specific immunizations, the programme has not yet achieved targets for full and complete immunization and especially lags in results for rural districts. In 1993, there was a 23 percentage point differential in the rates for complete immunization of children aged 12 to 23 months between urban and rural communities. The rural-urban differential was reduced to 14 percent in 1998 and further to 10 percent in 2003 (see Figure 2).

Despite the reduction in the rural bias, rural rates for children aged 12-23 completely immunized at any time before the survey were still low at 66 percent (Ghana Demographic Health Survey 1998, 2000, 2003).

By 1998, the District Health Management Team Nkwanta District had established sub-district health facilities in five clinical locations. Much of the population remained underserved, however, and deliberations focused on means of addressing community health service needs. Constrained resources, extreme poverty and cultural isolation of remote villages, with a broad diversity of ethno-linguistic groups dispersed across the district, prevented positive health-seeking behavior at formal health facilities even where geographical access was possible. Formal institutions of health were out of reach for the majority of Nkwanta's traditional society, which saw the new structures as exogenous to their way of life. In response, Nkwanta district was the first in the nation to implement CHPS. This programme represented a national policy framework for scaling up community health service strategies that had been successfully demonstrated by the Navrongo Health Research Centre in northern Ghana. Evidence from Navrongo demonstrated that infant and child mortality decreased after nurses were placed in village health compounds who provided 24-hour doorstep care (Binka, et al. 2006).

One of the main attributes of the CHPS programme model is the involvement of traditional leadership. The community health planning process is developed by holding meetings and educative talks, called *durbars*, regarding common health problems that need to be addressed by the programme. Community leaders and volunteers are provided with the means to construct and maintain a local village clinic, known as the Community

Health Compound, where the nurse resides and provides out-patient clinical services. The grass-roots participatory methods of the programme guarantees local ownership of the health development process, including the formation of a committee that organizes communal health action and communication.

In addition to preventive care and community education, certified nurses, specifically trained in community-based health care, provide home treatment for malaria, acute respiratory infection, diarrhea and other childhood diseases, as well as safe motherhood, family planning and comprehensive immunization services. After the completion of their additional training and posting to the community-level, nurses are promoted to the title, Community Health Officers (CHO). Community health volunteers are recruited to assist the daily activities of the CHO and support the social mobilization aspects of the programme, particularly activities that involve the engagement of both traditional male and female leaders.

Barriers to immunization.

Structural barriers. There are several 'structural' reasons that might explain why rural Ghana has not yet been able to attain national rates of coverage. First, spatially dispersed households and communities with lower population density increase the costs of health care for both provider and client. Rural districts have severe resource constraints with several districts devoid of a public health physician and other districts with doctor: population ratios as low as 1:187,000 in Nkwanta District.[5] Fewer per capita resources, in terms of budget, infrastructure and personnel, reduce the ability to cover all areas of

the district and inevitably increase costs for patients faced with longer travel and wait times.

Second, opportunities to immunize children on time are 'missed' due to seasonal migration associated with semi-nomadic agrarian and herding practices, as well as rural market activities along historic trading routes and networks. Agriculturists do not have to travel far from their community to be out of reach of the nearest health post or facility. Many farming settlements and fishing villages in rural Ghana are located in geographically inaccessible areas that lack modern transportation and public roads, or are separated by rivers, lakes and mountainous terrain.

Finally, since immunization is associated with higher levels of household wealth, mother's educational attainment, and literacy, low levels of human development in rural districts contribute to lower immunization rates. Besides constrained per capita private and public resources available, gender inequality in education, employment, freedom of movement and household decision-making power could greatly affect a mother's success in completely immunizing her children.

Social barriers to rural immunization. Traditional rural societies have developed long-standing medical and spiritual epistemologies for treating and preventing illness; epistemologies that are part and parcel with culture, religion and simply 'this is what we do and how we do it'. As with any externally introduced medical technology, immunization programmes may face several forms of 'social resistance' that require consensus building before wide-spread adoption occurs (Mokyr, 1998 and Palloni 1999). This is especially true in resource constrained health settings that depend on a mobilized system of community volunteers to educate, convince, and assist in service delivery and

record keeping. Potential new acceptors of immunization will be persuaded only after observing their neighbours' actions and resulting outcomes. Community-based education, in which individuals are introduced to the benefits and mechanisms of immunization as a collective, is therefore an important aspect of social learning and change.

Besides ideological and epistemological social resistance, the size and composition of communities may affect the pace of acceptance (Mokyr 1998). A district that is composed of independent fragmented communities that have unique tribal leadership and are delineated based on ethnic, religious or political identities may be more vulnerable to epistemological resistance to behavioral change, since it is easier to question or ignore an external authority. Therefore, a community-based programme that is designed, planned and managed at the village-level in partnership with traditional tribal leaders and opinion leaders will be more appropriate and efficient in gaining acceptance from the perspective of both individual and collective action. Also, successful outcomes that depend on critical mass acceptance rates may be easier to achieve in the smallest and most homogenous administrative unit available, the rural village, or town, instead of the district or even sub-district levels (Mokyr, 1998).

Data and methods

This assessment is based on a 2004 random cluster sample survey known as the Nkwanta District CHPS Evaluation Survey (NDES). In March 2004, 16 field interviewers, four supervisors and four translators were trained to carry out interviews in 895 households where there were 1,159 resident female respondents of reproductive age

(15-49 years). Sample households were dispersed in 60 Enumeration Areas (EAs) or clusters. Measurements of basic well-being and health indicators include literacy, household wealth, migration, morbidity, fertility, neonatal and child mortality, health service utilization, immunization coverage, family planning knowledge and use, as well as HIV/AIDS knowledge, condom use and risk perception. The objective of this survey was to evaluate the effectiveness of the CHPS service delivery strategy in changing health behavior and outcomes.

This analysis includes descriptive analysis comparing the children of female respondents who live in CHPS zones versus children who live in survey clusters not covered by CHPS. Using a test of means, this paper hypothesizes that there will be a positive association between CHPS and administrative record-keeping for children 12 to 59 months of age. A logistic regression is also used to test the strength of the positive association between CHPS and complete immunization while controlling for other socio-economic characteristics of the child's mother and household. These independent variables include: sex of the child, mother's education, household wealth quintile, mother's religion, ethnicity, migratory patterns and access to public transportation. All of these variables represent both structural and social barriers to rural health care that CHPS aims to address.

Data limitations

The Nkwanta District Evaluation Survey (NDES 2004) has several limitations for this analysis. The Nkwanta District Health Directorate established CHPS in communities that were classified as 'deprived but ready'. Indicators that were used to establish deprived

areas included distance to an established health centre, socio-economic characteristics, cultural isolation and health indicators, such as high fertility and child mortality.

Locations for the Community Health Compounds were also chosen for their accessibility to public roads, due to the necessary logistics of building a health compound and transporting equipment and supplies from the district hospital and administrative offices. Communities were deemed ready for CHPS once they were also able to mobilize a Volunteer Health Committee and communal labour for assisting in the construction of the Community Health Compound. Villages that did not have clear leadership, that were experiencing tribal conflicts or lacked essential infrastructure were not able to accommodate a Community Health Officer in the locality. In conclusion, the process of selecting communities for programme participation presents several problems of endogeneity for the present analysis: 1) different levels of programme exposure, both in terms of time and geographical proximity, 2) variance in initial poverty and health indicators, as well as local administrative capacity, and 3) community willingness to embark on the programme.

As a cross-sectional survey collection instrument, the 2004 NDES does not include the immunization records of children who are living in the household but whose mother is either absent, deceased, or otherwise unavailable for interview. Also, due to traditional belief systems regarding deceased children, respondents undoubtedly omitted deceased children from the recall of events in fertility histories and were consistently unable or unwilling to provide dates of birth and completed immunizations for their deceased children. Since it was impossible to determine the birth cohort and immunization dates of deceased children, only surviving children have been included in

this analysis. Since immunization contributes to survival, coverage reported in the survey over-estimates the true coverage of immunization in this population.

The collection of data regarding whether or not a child has been given a specific immunization on time requires complete and correct health records administration. There are three plausible scenarios for households with missing immunization health cards 1) the child never received immunization services and therefore never was given a card by a health provider; 2) the child initially had a card, which was lost or discarded due to either discontinuation or completion of her immunization schedule; 3) the respondent couldn't find the card, or the card was with the child's health facility or provider. Past examples of immunization research have either presumed children without health records were never immunized or were immunized at the same rate as children with cards. This analysis however estimates sample immunization rates based on the available data for children with administrative health records.

All children in the immunization roster, regardless of their health record status, were examined by interviewers for whether or not they had a BCG scar on their upper left arm. Based on this report, it was found that 87 percent of children with immunization cards had a BCG scar as compared to only 40 percent of children without cards. In order to estimate the coverage rates for each immunization, the authors first calculated the joint probability that a child with health records would receive each subsequent immunization given their BCG scar status and applied these probabilities to the proportion of children without records that did and did not have a scar. This analysis, therefore, does not assume equal proportions of immunization between groups, but does assume equal joint probabilities in association with BCG scar results. Since this method can only apply to

aggregate coverage rates, it is not used in the logistic regression for predicting complete immunizations.

Results

CHPS coverage. Since 1998, Nkwanta has had eight CHPS implementation zones in operation. Thirty-nine percent of female respondents have a CHPS Community Health Compound as their nearest health facility and 27 percent of the sample population lived in a community demarcated as being in a CHPS zone.

CHPS has reduced the geographical distance to the nearest facility for 21 out of the 60 sampled clusters. On average, these 21 clusters were 22.37 km away from their nearest health facility before CHPS was implemented in their communities. After CHPS was implemented, these communities were on average a distance of 8.99 km from the nearest CHPS Community Health Compound. This represents an average decrease of over 13 km for 35 percent of the sampled clusters.

Ethnicity, religion, migration and education. The 2004 Nkwanta District Evaluation Survey has identified 26 distinct ethnic groups among the female sample population. Ethnic diversity has been due to historic, as well as recent migratory and settlement patterns. The Konkomba ethno-linguistic group represents a majority 48 percent of the sample population, despite the fact that they are not indigenous to the district. Most of the Konkomba migration from the northern regions occurred as a result of 1994-96 ethnic conflict in the neighbouring Northern Region leading to 2,000 deaths and the displacement of 200,000 villagers residing in 440 decimated villages.[6]

Sixty percent of the Konkomba tribe mentioned traditionalism as their main form of worship. The next most traditional ethnic group was the indigenous tribe, Achude,

with 26 percent reporting a traditionalist identity. Although Christianity was the predominant main religion reported by the total sample, it is important to note that there are several traditional beliefs and practices which are pervasive across all religious affiliations.

A considerable proportion of female respondents reported having lived in their community for less than five years (16.3 percent); and almost 6 percent of female respondents have lived in their present community for less than two years. There is no significant difference between the migration status of women currently living in CHPS zones and those living in non-CHPS clusters. Approximately 20 percent of both CHPS and non-CHPS respondents either temporarily or seasonally migrate outside of their community for work.

Over 70 percent of the sample population has never completed primary school. Female respondents living in clusters covered by CHPS are more likely to have never completed primary school than females in non-CHPS sample clusters. Eighty percent were illiterate, 14 percent could read with difficulty, and only 6 percent stated that they were literate with ease. The Konkomba tribe had the highest illiteracy and lowest educational attainment rates among the sample. Ninety percent of Konkomba women had never completed a primary education and only 5 percent were literate in comparison to 34 percent of other ethnicities.

Descriptive statistics show that the district-wide coverage of immunization cards remains substantially lower than national or regional estimates (see Figure 3). Only 60 percent of children covered by the survey had health record cards. As a rural and economically deprived district, overall EPI antigen rates are also lower than national and

regional results (see Figure 4). However, when comparing areas participating in Community Health Planning and Services (CHPS) versus basic EPI services, the CHPS strategy has fostered a significant 14% increase in the maintenance of administrative health cards and is associated with a 66% increased chances of complete immunization for children 12 to 59 months at the time of the survey (see Tables 1-2). In fact, CHPS has surpassed national and regional rates of complete immunization as can be seen in Figure 6. Figure 7 shows that at each age children living in a CHPS zone have both a higher average of vaccinations and are more likely to be completely vaccinated at an early age than children not living in an established CHPS zone. These results suggest that CHPS is a more successful strategy for attaining international immunization standards than EPI alone.

Table 2 investigates the determinants of full immunization further, testing the hypothesis that CHPS effects are robust even after the introduction of multiple statistical controls for maternal characteristics. The univariate regressions demonstrate gross effects for CHPS exposure, maternal age and parity, educational attainment, household wealth, and Konkomba ethnicity. In comparison to the bottom 40th percentile, children belonging to households in the least poor 20th percentile group were almost 3 times more likely to have complete inoculation. The Konkomba tribe has more than 30 percent decreased odds for immunization completion. Children with mothers who identified themselves as mainly traditionalists are associated with a 40 percent decrease in the chances of receiving the complete immunization schedule.

Predictably, children whose mother migrated in the past 5 years had 60 percent decreased immunization odds, since migration disrupts the immunization schedule as

well as proper record-keeping. Children whose community had access to public transportation and passable roads were more than 2 times as likely to be immunized completely. Finally, children living in a survey cluster with CHPS programme exposure were 1.5 times as likely to be completely immunized. CHPS exposure net effects are significant in the multivariate model, suggesting that exposure has an additional impact that cannot be entirely attributed to the socio-economic determinant controlled for in this model.

Discussion and conclusions

These results indicate that CHPS has made significant impact in decreasing geographic inequity in immunization coverage in Nkwanta District. Using the last DPT3 immunization as an indicator of discontinuing the immunization schedule, non-CHPS areas have 58 percent coverage rates as compared to the 74 percent coverage rates in CHPS clusters. This approximates international standards of at least 80 percent at the district level, but is well below the 90 percent national standard. When comparing goals for complete and on time immunization, CHPS clusters (65 percent) are not only higher than non-CHPS areas (53 percent) but have even surpassed the national levels in 2003 (55 percent).

While CHPS improves coverage, evidence is consistent with the conclusion that further improvement is needed. Apart from the important geographic effect on extending coverage to remote communities, there is no evidence that exposure to community-based care offsets the impact of traditional beliefs on immunization. Estimation of a logistic regression model suggests that ethnicity, non-traditional religious beliefs and high

relative wealth are associated with greater odds of complete and on time coverage in CHPS exposed and unexposed communities alike. Such results suggest that CHPS sponsored immunization promotional strategies should bring traditional belief systems into account so that communication and education activities offset traditional social resistance to inoculations. Mobilizing traditional healers and spirtualists, existing social networks, farmer settlements, market associations and women's groups in more impoverished areas, may promote acceptance of immunization rates among illiterate and poor communities

Migration status of a child's mother in the past five years represents a significant determinant of complete immunization. This points to a need for innovative approaches to extending immunization coverage to isolated communities that have relatively high rates of migration.

Despite problems that are noteworthy, the CHPS community based strategy is a significant improvement over the conventional outreach clinic approach. Nearly two-thirds of Ghana's children aged 12 to 23 months reside in rural areas. Expanding the CHPS programme is likely to increase complete and 'on time' rural immunization rates in rural and remote areas of Ghana. The CHPS community health service model merits systematic trial in other health deprived West African countries.

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Table 1. Comparison of Nkwanta District child immunization service components, mechanisms and models (CHPS vs. EPI and IMCI)

	Service component	**Point of delivery**	**Mechanism**	**Model**	**Access**
(i)	Routine visits/ out-patient primary care	(a) Static health facility†	(a) EPI (b) IMCI **(c) CHPS**	Client → provider	Regular visiting hours
(ii)	Child Welfare Clinic	(a) Static health facility (b) Static community outreach post	(a) EPI (b) IMCI **(c) CHPS**	Client → provider→ community	Monthly
(iii)	Mass immunization campaigns (Polio NID, disease outbreaks)	(a) Community (b) Household (c) Schools (d) Transportation hubs (e) Markets (f) Border crossings	(a) EPI (b) DHMT Disease Control Unit **(c) CHPS**	Provider→ community	Semi-annual; as necessary
(iv)	Supply-driven (to reduce wastage of opened vaccine vials)	(a) Community (b) Household (c) Markets	(a) EPI **(b) CHPS**	Provider→ client	Event-based
(v)	Routine door-to-door canvassing	(a) Household	**(a) CHPS**	Provider→ client	Semi-monthly
(vi)	Demand-driven doorstep care	(a) Household	**(a) CHPS**	Community→ provider → client	Event-based (e.g., newborn)
(vii)	Community mobilization and education	(a) Community	**(a) CHPS**	Provider→ community	On-going
(viii)	Community volunteerism	(a) Community	(a) EPI **(b) CHPS**	(a) Client → volunteer (b) Volunteer→ client	On-going

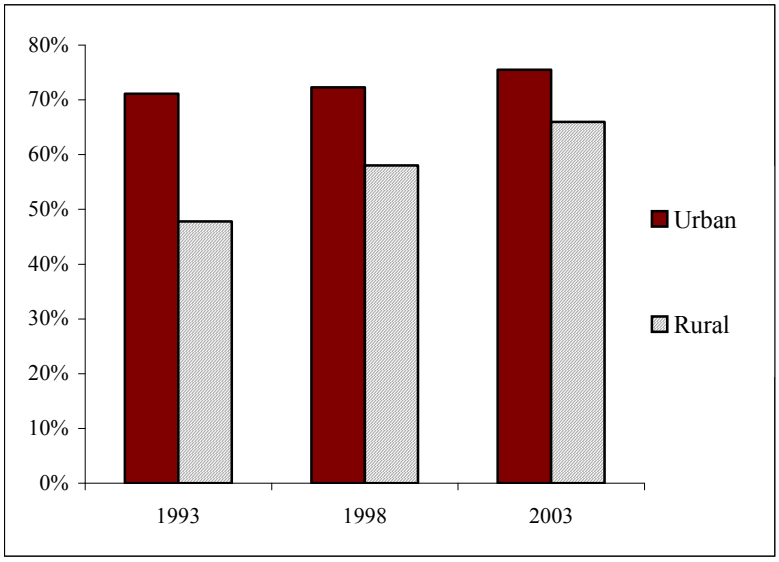
†Note: Static health facilities include:

- Sub-district Health Centre
- Clinic (private and public)
- District Hospital MCH unit
- Community Health Compound (CHPS only)

Table 1. Nkwanta District EPI % coverage by year and specific antigen

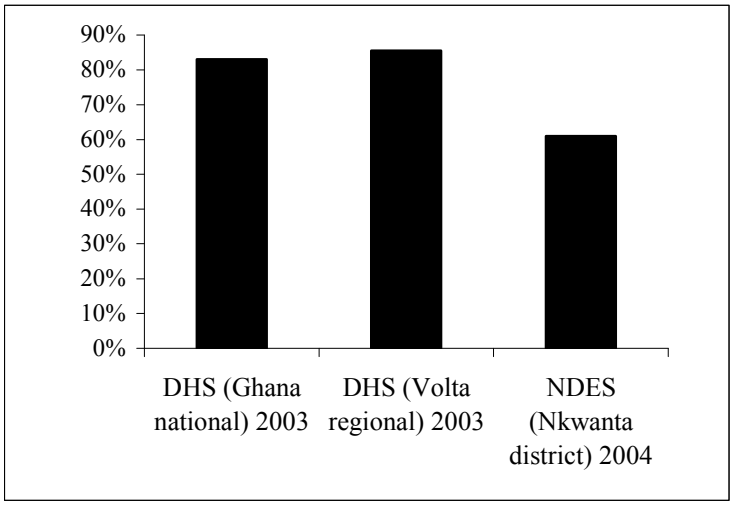
ANTIGEN	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
BCG	31.2	30.5	52.1	60.0	78.9	86.7	89.2
MEASLES	23.6	27.7	33.6	48.1	58.4	66.7	76.8
OPV3	16.3	19.0	35.1	37.3	56.9	60.4	72.6
DPT3	16.2	18.6	35.3	37.3	57.1	60.8	71.1

Figure 2. Percent of children age 12-23 months who received all immunizations before survey, not including Yellow Fever, DHS 2003



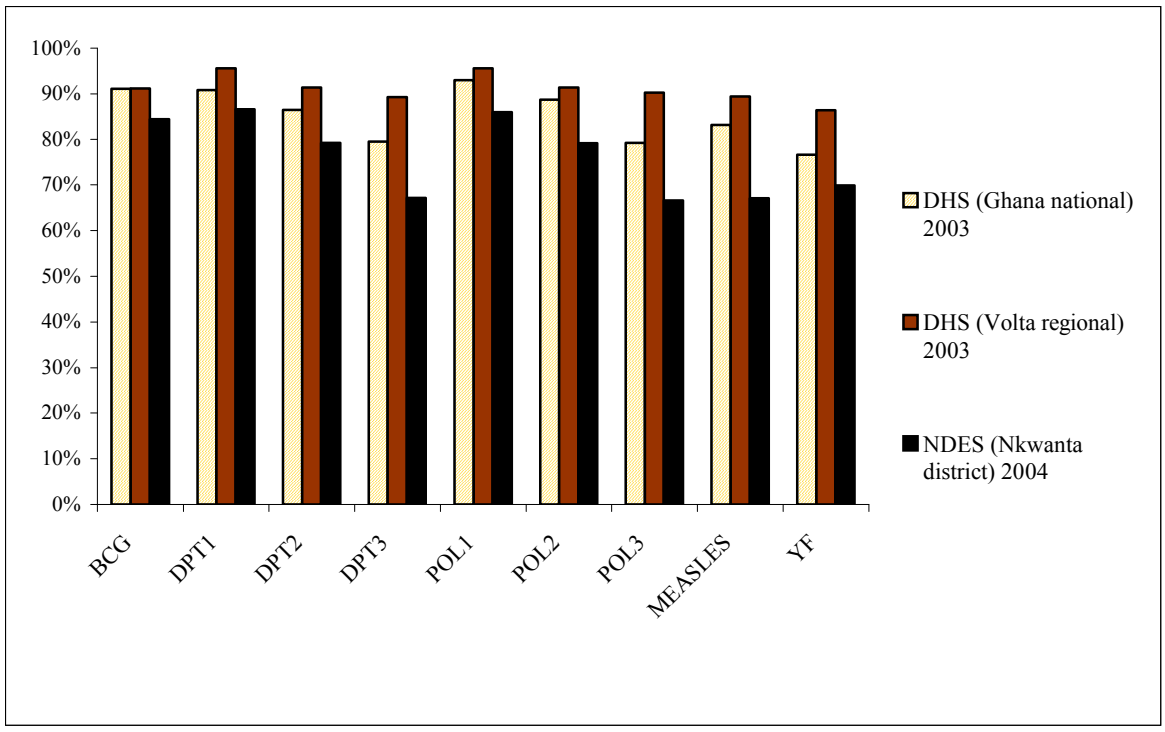
Source: Ghana Demographic and Health Surveys 2003.

Figure 3. Percent of children age 12-23 months with immunization health cards, national, regional and district levels, DHS 2003 and NDES 2004



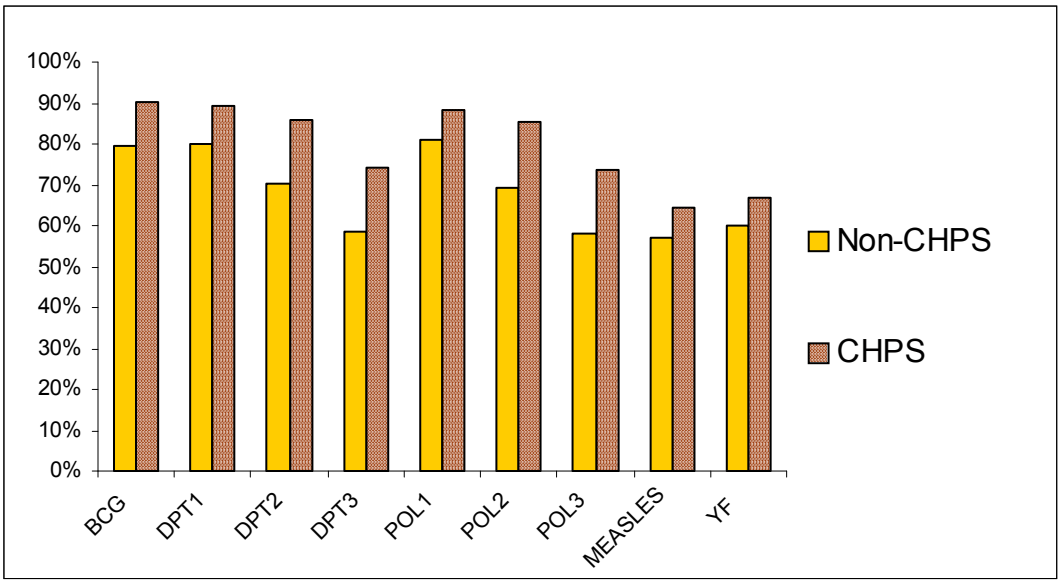
Source: Nkwanta District Evaluation Survey, Nkwanta Health Development Centre, Ghana Health Service, 2004 and Ghana Demographic and Health Surveys 2003.

Figure 4. Percent of children age 12-23 months immunized, by specific inoculation, national, regional and district levels, DHS 2003 and NDES 2004



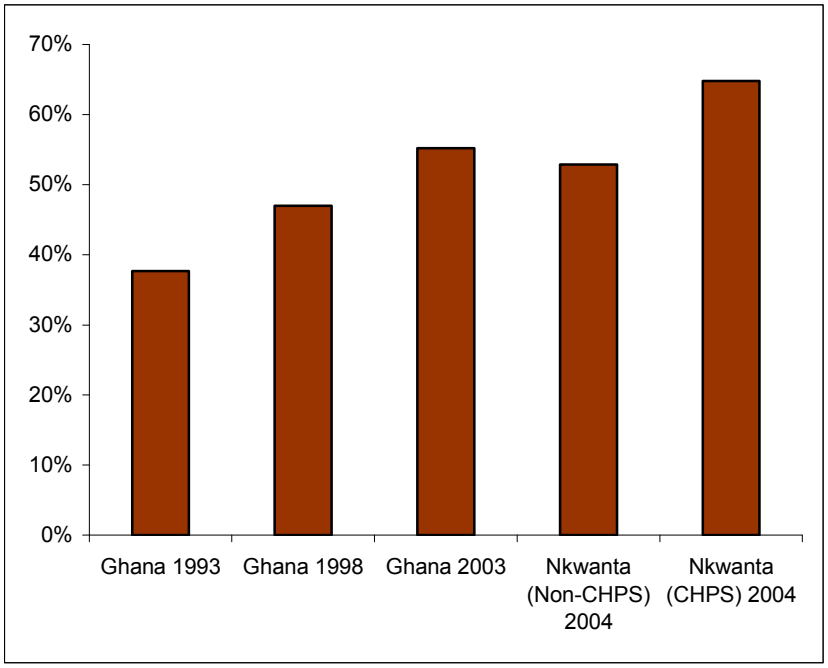
Source: Nkwanta District Evaluation Survey, Nkwanta Health Development Centre, Ghana Health Service, 2004 and Ghana Demographic and Health Surveys 2003.

Figure 5. Percent of children age 0 to 59 months immunized, by specific inoculation and CHPS exposure, Nkwanta DES 2004



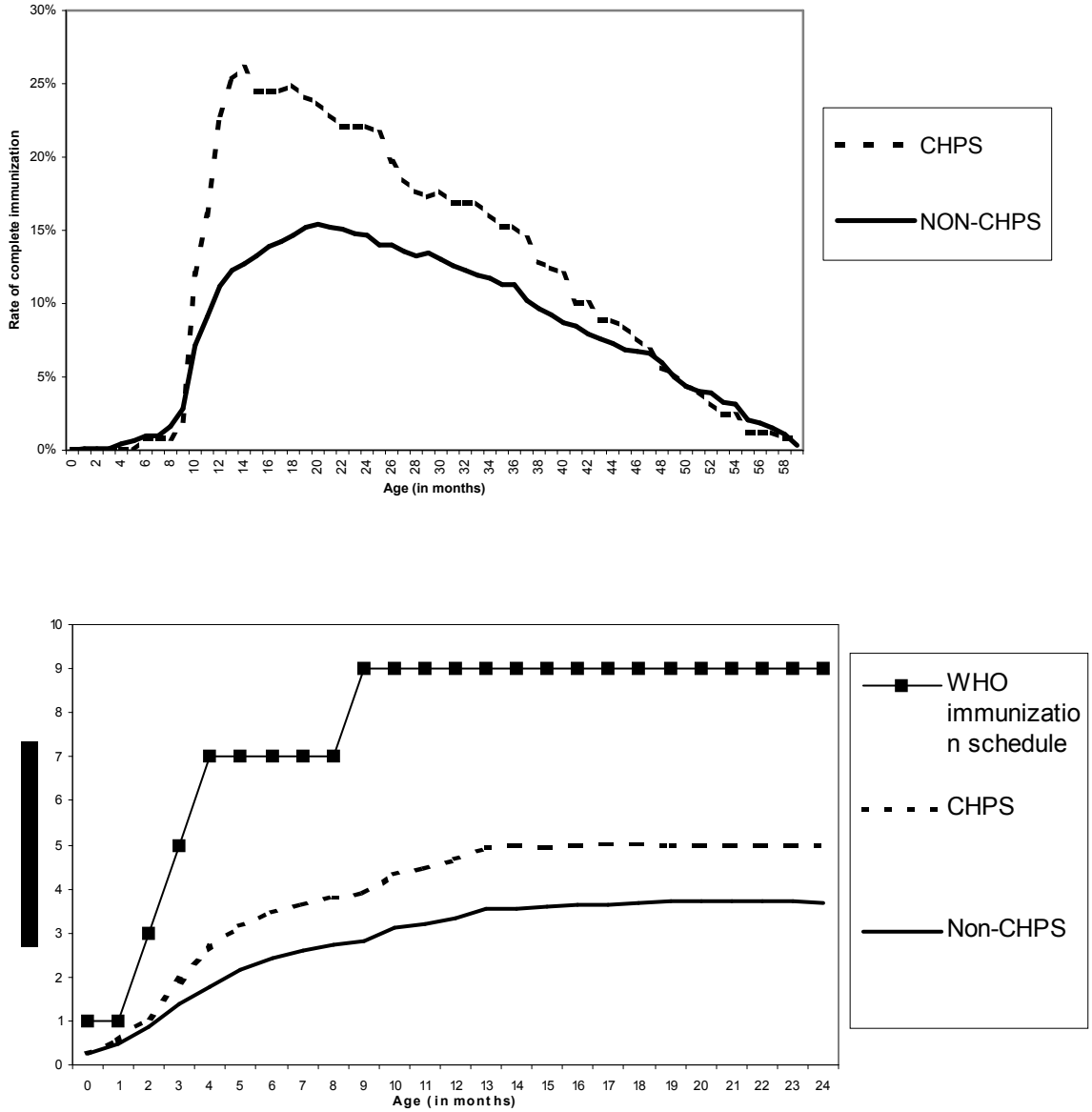
Source: Nkwanta District Evaluation Survey, Nkwanta Health Development Centre, Ghana Health Service, 2004

Figure 6. Percent of children age 12 to 35 months completely immunized (not including Yellow Fever), national and district comparison



Source: Nkwanta District Evaluation Survey, Nkwanta Health Development Centre, Ghana Health Service, 2004 and Ghana Demographic Health Surveys 1993, 1998 and 2003.

Figure 7. Age-specific rates for complete immunization and average number of vaccinations received in comparison to the WHO immunization schedule for the 1999-2004 birth cohort



Source: NDES 2004.

Table 1. Percent of children 0 to 59 months with immunization health record cards,

Group	Obs	Mean(%)	Std. Err.	Std. Dev.	[95% Conf.	Interval]
NON-CHPS	921	**58%**	0.0163	0.4935	0.5501	0.6139
CHPS	249	**72%**	0.0285	0.4505	0.6627	0.7751
combined	1170	**61%**	0.0143	0.4877	0.5831	0.6391
diff		**-14%**	0.0346		-0.2048	-0.0690
		P< t= 0.00				

NDES 2004

Source: Nkwanta District Evaluation Survey, Nkwanta Health Development Centre, Ghana Health Service, 2004

Table 2. Determinants of complete immunization records, children 12 to 59 months

	Univariate Models		Multivariate Model	
Variable	**Odds Ratio**	**Sig.**	**Odds Ratio**	**Sig.**
Programme exposure				
Non-CHPS	1.00		1.00	
CHPS	1.66	**	1.50	*
Sex of child				
Male	1.00		1.00	
Female	1.02		0.87	
Age of mother				
15-24	1.00		1.00	
25-34	0.76		0.88	
35+	0.56	*	0.69	
Household wealth				
Lowest 40 percent	1.00		1.00	
Middle 40 percent	2.30	****	1.79	**
Highest 20 percent	4.50	****	2.56	**
Mother's education				
None	1.00			
Primary	1.64	*	0.84	
Middle/JSS+	3.27	****	1.49	
Parity				
1-2	1.00		1.00	
3-4	0.70		0.84	
5+	0.53	**	0.96	
Ethnicity				
Other			1.00	
Konkomba	0.47	****	0.67	*
Traditional worship				
No			1.00	
Yes	0.38	****	0.60	**
Migration (5 years)				
No			1.00	
Yes	0.65	*	0.41	***
Labour migration			1.00	
No				
Yes	1.14		1.04	
Public transport				
No			1.00	
Yes	2.29	****	2.09	***

Source: Nkwanta District Evaluation Survey, Nkwanta Health Development Centre, Ghana Health Service, 2004

Note: only includes children with immunization health records seen by interviewer.

*….

Endnotes

[1] EPI was initiated by UNICEF, World Health Organization (WHO) and the World Bank.

[2] XXX Penta quote

[3] Refer to the previously published articles, Nyonator et al., "The Ghana Community-based Health Planning and Services Initiative for scaling-up service delivery innovation", *Health Policy and Planning*, January 2005 Volume 20(1) and Awoonor-Williams, et al., "Bridging the Gap Between Evidence-Based Innovation and National Health-sector Reform in Ghana", *Studies in Family Planning*, Volume 35(3), September 2004 for a detailed description of the CHPS national policy, its implementation, and evidence-based research results of its impact.

[4] UNICEF 2005 goals: "Ensure full immunization of children under one year of age at 90 per cent nationally, with at least 80 per cent coverage in every district or equivalent administrative unit." WHO/UNICEF: Immunization Summary 2005 - A Statistical Reference, http://www.childinfo.org/areas/immunization/, site visited on 05 December 2005.

[5] Awoonor-Williams, et al. "Bridging the Gap Between Evidence-based Innovation and National Health Sector Reform in Ghana" , *Studies in Family Planning*, Vol. 35(3), September 2004, pp. 161-177

[6] Author's 2004 field notes and interviews. And "Exclusion, Association and Violence: Trends and Triggers in Northern Ghana's Konkomba-Dagomba Wars", The African Anthropologist Vol.10(1) 2003: 39-82.