

Increase in facility-based deliveries associated with a maternal health voucher programme in informal settlements in Nairobi, Kenya

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Objective	To measure whether there was an association between the introduction of an output-based voucher programme and the odds of a facility-based delivery in two Nairobi informal settlements.
Data sources	Nairobi Urban Health and Demographic Surveillance System (NUHDSS) and two cross-sectional household surveys in Korogocho and Viwandani informal settlements in 2004–05 and 2006–08.
Methods	Odds of facility-based delivery were estimated before and after introduction of an output-based voucher. Supporting NUHDSS data were used to determine whether any trend in maternal health care was coincident with immunizations, a non-voucher outpatient service. As part of NUHDSS, households in Korogocho and Viwandani reported place of delivery and the presence of a skilled birth attendant (2003–10) and vaccination coverage (2003–09). A detailed maternal and child health (MCH) tool was added to NUHDSS (September 2006–10). Prospective enrolment in NUHDSS-MCH was conditional on having a newborn after September 2006. In addition to recording mother's place of delivery, NUHDSS-MCH recorded the use of the voucher.
Findings	There were significantly greater odds of a facility-based delivery among respondents during the voucher programme compared with similar respondents prior to voucher launch. Testing whether unrelated outpatient care also increased, a falsification exercise found no significant increase in immunizations for children 12–23 months of age in the same period. Although the proportion completing any antenatal care (ANC) visit remained above 95% of all reported pregnancies and there was a significant increase in facility-based deliveries, the proportion of women completing 4+ ANC visits was significantly lower during the voucher programme.
Conclusions	A positive association was observed between vouchers and facility-based deliveries in Nairobi. Although there is a need for higher quality evidence and validation in future studies, this statistically significant and policy relevant finding suggests that increases in facility-based deliveries can be achieved through output-based finance models that target subsidies to underserved populations.
Keywords	Reproductive health, maternity services, health financing, vouchers

KEY MESSAGES

- This paper is the first to present evidence on an association between the use of vouchers and an increase in facility-based maternal deliveries in the African region.
- There were significantly greater odds of a facility-based delivery among respondents after the voucher programme started compared with similar residents in the survey prior to programme launch.
- This statistically significant and policy relevant finding suggests that increases in facility-based deliveries can be achieved through an output-based voucher finance model that targets demand subsidies to underserved populations.

Introduction

Recent national surveys in Kenya have estimated that approximately 6500 women die from childbirth-related causes each year (450–500 deaths per 100 000 live births) (KNBS and ICF Macro 2009). The lack of skilled medical assistance during delivery jeopardizes the lives of both mother and newborn; unattended delivery is one of the greatest risk factors for maternal mortality and morbidity. As such, the 5th Millennium Development Goal calls for a greater proportion of women to be delivered by a skilled attendant as a key mechanism to reduce maternal mortality.

Although the majority of pregnant women attend antenatal care (92%), only 44% of deliveries in Kenya are facility-based (KNBS and ICF Macro 2009). The probability of delivery at a health facility is significantly associated with women's education and wealth (Gill *et al.* 2007). Although Nairobi province has a much higher proportion of facility deliveries compared with the national average (89% vs 44%) in the 2008/09 Kenya Demographic and Health Survey (KDHS), there is an economic gradient in which the wealthiest quintile had an extremely high percentage of facility deliveries (98%) compared with a much lower proportion (73%) among the poorest quintile.

One approach to increasing facility-based deliveries among the urban poor is to subsidize the cost of facility-based deliveries through an output-based approach (OBA) using vouchers to finance demand and reimburse skilled providers for deliveries (Ensor 2004; Yamamoto 2004). Voucher programmes provide incentives to patients and health care workers with several goals in mind: to improve provider quality, to stimulate patient use of selected services, to target services to high-priority populations, and to contain costs (Steuerle 2000; Mushi *et al.* 2003).

Voucher programmes for health services are of increasing interest to governments, practitioners and funders. Output-based health care vouchers were first used in low-income countries on a large scale for family planning services in Taiwan and Korea in the 1960s and 1970s (Cernada and Chow 1969; Ross *et al.* 1970; Lin and Huang 1981). A Nicaraguan non-profit organization used sexual and reproductive health vouchers from 1995 onward to subsidize priority health services for sex workers and adolescents (Borghini *et al.* 2005; Gorter *et al.* 2006; McKay *et al.* 2006; Meuwissen *et al.* 2006a; Meuwissen *et al.* 2006b; Meuwissen *et al.* 2006c; Meuwissen *et al.* 2006d). More recently reproductive health voucher programmes have been tried in Uganda, Kenya, Bangladesh, Pakistan and India. In two recent systematic literature reviews, 13 and 16 reproductive health voucher programmes, respectively, were identified between 1961 and 2009, with more voucher service programmes

launched in the first decade of the 21st century than in the preceding 40 years (Bellows *et al.* 2010; Meyer *et al.* 2011).

The Kenyan government has recognized the need for greater efficiency, effectiveness and equity in the health sector. To reduce health inequalities and provide access to those excluded from health care for financial reasons, the national multi-sectoral development strategy, Vision 2030, called for the creation of a mandatory National Health Insurance Scheme in order to promote equity in Kenya's health care financing, and to scale up the output-based approach system to enable disadvantaged groups (e.g. the poor, orphans) to access health care from preferred institutions (MOHPS and MOMS 2008). Complementary public health sector reforms are underway in the Health Sector Services Fund (HSSF), which channels operational budgets directly to public facility management committees rather than to district managers (Opwora *et al.* 2009). Such a mechanism, if properly resourced and managed, can complement output-based voucher reimbursements to facilities and further normalize efficient decision-making at the service provider level. However, evidence is needed to determine the relative strengths and weaknesses in proposed health finance strategies.

This paper is the first to present evidence from the household level of an association between the introduction of output-based vouchers and increases in facility-based deliveries in Kenya. With donor support from the German Development Bank (KfW), the Kenya Ministry of Planning began maternal health care and family planning voucher services in June 2006 to subsidize poor women's access to long-term family planning and safe motherhood, to improve their choice of facility and to reimburse accredited facilities for providing care (Bellows *et al.* 2009; Janisch *et al.* 2010). The first phase of the pilot programme used vouchers to empower clients' choice of 54 contracted providers in public, non-government organization (NGO), faith-based and private facilities: 7 facilities in Kitui district, 17 facilities in Kiambu district, 18 facilities in Kisumu district and 12 facilities in Nairobi (Janisch *et al.* 2010).

Voucher distributors screened expectant women on a 14-item poverty grading tool measuring food security, household assets and access to health care (Porksens 2003). Women who scored low enough were eligible to buy a safe motherhood voucher for 200 Ksh (~US\$2.50). The voucher covered four antenatal care visits, a facility-based delivery including caesarean section and treatment of other mother and neonatal complications if necessary, and postnatal care. Facilities were reimbursed 1000 Ksh for clients who completed four antenatal care (ANC) visits, 4000 Ksh for a normal delivery and 20 000 Ksh for a caesarean section. Additional complications were reimbursed on a

fee-for-service basis (Bellows *et al.* 2009). All reimbursements required a claim for treatment according to contractually agreed and nationally established standards of care (Janisch *et al.* 2010). By the end of phase 2 (October 2011), more than 120 000 pregnant women had benefited from the pilot voucher programme in Kenya (Gorter and Bayou 2011).

To determine whether the Kenya voucher programme was associated with increases in the proportion of women from Nairobi informal settlements delivering at a facility, this paper reports results from two surveys conducted before and 12–24 months after the voucher programme launch in Korogocho and Viwandani. To show historical trends, data are drawn from the Nairobi Urban Health Demographic Surveillance System (NUHDSS) for 2003 to 2010 for facility-based deliveries in the urban slums. Immunization data from NUHDSS for the same period permit a falsification exercise. The maternal and child health (MCH) tool in NUHDSS allows birth histories and voucher use to be compared for women who gave birth from 2006 to 2010.

Methods

Data

Two data sets were collected in the informal settlements of Korogocho and Viwandani—the two communities targeted by the pilot voucher programme in Nairobi. Both data sets are nested in the longitudinal NUHDSS which has been on-going since 2003 and covers about 60 000 individuals living in about 23 000 households in the two slum communities. Korogocho and Viwandani are located about 5–10 km from the city centre and occupy an area of less than 1 km² in size.

The first dataset included all females aged 12–54 years who were registered in the NUHDSS and had either a live birth or stillbirth from January 2004 to December 2005. Visitors not registered in the NUHDSS as well as women whose pregnancy outcome was uncertain were excluded in this study. Data collection was conducted between May and July 2006. There were 2482 women with deliveries registered in the NUHDSS. Of these, 7% (183) had since out-migrated from the NUHDSS sites or had died, resulting in 2299 women for the household survey in May–July 2006. For reasons such as ‘unknown at residence’ and ‘respondent not found after three call-backs’, out of the 2299 women, 1970 were successfully interviewed. Following thorough review of questionnaires during data entry, 43 forms were discarded. Only 1927 were entered by the data entry clerks, resulting in interviews for 78% of all NUHDSS registered births ($1927/2482 = 78\%$).

The second dataset included all females aged 12–54 years (and their children) who had given birth in the two informal settlements from September 2006 to December 2008. Each woman was visited once every 4 months to collect information on the health of the mother and child. The OBA voucher questions were asked during the second visit. A total of 2448 women who delivered between September 2006 and December 2008 were successfully interviewed. Comparing this figure with the NUHDSS registry of 3897 women with live births or stillbirths in Korogocho and Viwandani for the same period, 63% were successfully interviewed ($2448/3897 = 63\%$).

The same NUHDSS dataset contained an MCH tool that included all females between 12–54 years in the sampling frame who had given birth in the two informal settlements from September 2006 to December 2009. Visitors not registered in the NUHDSS as well as women whose pregnancy outcome was uncertain were excluded in this study. Data collection was conducted quarterly, following up new mothers recorded in the NUHDSS 3–4 months after delivery. Between September 2006 and December 2009, 73% of mothers recorded in the NUHDSS were interviewed using the NUHDSS-MCH tool, which recorded use of the OBA voucher, location of delivery and related perinatal outcomes.

Analysis variables

The first outcome variable is whether or not a woman had a delivery in a health facility, comparing respondents who delivered in 2004–05 (before introduction of the OBA voucher) with those delivering in 2006–08 (after the introduction of the voucher). The second outcome variable is whether or not a woman had a skilled attendant at delivery. This is to examine the possibility that vouchers shifted expectant women from home delivery with a skilled attendant to facility delivery. The third outcome was use of vouchers among women in the second survey to identify characteristics associated with voucher use.

Table 1 includes respondent socio-economic and demographic characteristics. Respondent residence is a binary variable coded for Korogocho and Viwandani slums. Socio-economic status (SES) of the household is coded as a binary variable (poor and least poor). SES was constructed using principal components analysis (PCA) using information about dwelling characteristics and possessions. After using PCA, the continuous variable was split at the median value into poor and least poor. Mother’s age at delivery was presented in three categories (12–23, 24–34, 35+ years old); mother’s parity was categorized into four levels (1, 2, 3, 4+ births) and mother’s educational status was grouped into three levels (none, primary and secondary or higher).

Analytic methods

To present utilization trends and conduct a falsification test, yearly proportions of facility-based deliveries from 2003–2010 and immunizations from 2003–2009 are presented from NUHDSS data. The OBA voucher programme was introduced in June 2006. The two periods January 2004 to December 2005 and September 2006 to December 2008 provide a population-based before-and-after design to test the association between the introduction of the OBA voucher and improved maternal health outcomes among the urban poor.

We also conducted a cross-sectional analysis of the 2006–2008 data to determine what factors were associated with use of the voucher.

The outcome variables were reported as proportions. Bivariate and multivariate analyses were conducted and multivariable associations were reported using odds ratios and 95% confidence intervals. All statistical tests were two-sided and associations were considered significant at $\alpha < 0.05$. For each of the dichotomous outcomes, a logistic regression model was fit with

Table 1 Demographic characteristics of survey respondents ($N=4362$)

Variable	Entire sample	2004/2005	2007/2008	χ^2 (P-value)
Women with pregnancy outcome	4362	1914	2448	
Location				
Korogocho	54.1	57.0	51.8	11.53 (0.001)
Viwandani	45.9	43.0	48.2	
Mother's age at birth				
12–23	47.6	44.0	50.5	22.99 (0.000)
24–34	44.8	47.2	43.0	
35+	7.5	8.8	6.5	
Missing	0.05	0.0	0.08	
Parity				
1	29.6	24.9	33.3	54.18 (0.000)
2	27.8	28.0	27.7	
3	17.2	18.0	16.6	
4+	25.2	29.2	22.1	
Missing	0.2	0.0	0.3	
Mother's education				
None	21.1	8.7	30.8	346.6 (0.000)
Primary	53.8	66.1	44.2	
Secondary or more	25.1	25.2	24.9	
Missing	0.05	0.0	0.08	
Socio-economic status				
Poorest	50.1	50.2	50.0	0.011 (0.918)
Least poor	49.9	49.8	50.0	
Knowledge of maternal voucher				
Yes		0.0	76.1	
No		0.0	23.5	
Missing		0.0	0.4	
Purchased maternal voucher				
Yes		0.0	45.4	
No		0.0	54.5	
Missing		0.0	0.1	
Used maternal voucher				
Yes		0.0	90.0	
No		0.0	9.9	
Missing		0.0	0.1	
Facility-based deliveries				
Yes	68.7	64.7	71.8	25.71 (0.000)
No	31.3	35.3	28.2	
Skilled birth attendance				
Yes	72.2	69.9	74.1	16.89 (0.000)
No	27.6	30.2	25.6	
Missing	0.2	0.0	0.3	

the following independent variables: age group, parity, education, community site and household wealth group.

The 2006–08 dataset contained sufficient missing data to warrant imputation (between 8% and 14% for most covariates). For the 2004–05 survey, all the information was collected using

one tool with no missing data. However, in the second survey some of the data were collected in separate tools and merged later and not all observations merged successfully. SES had the highest frequency of missing data (11% missing). Missing values were imputed for mother's education, SES, parity and

Table 2 Logistic regression results comparing deliveries and skilled birth attendance before and after implementation of the output-based approach (OBA) voucher programme

	Facility deliveries		Skilled birth attendants	
	Odds ratio	(95% CI)	Odds ratio	(95% CI)
Timeframe				
Before OBA programme	ref.			
After OBA programme	1.4***	(1.19–1.58)	1.2**	(1.02–1.36)
Location				
Korogocho	ref.			
Viwandani	0.6***	(0.55–0.74)	0.7***	(0.64–0.87)
Mother's age at birth				
12–23	ref.			
24–34	1.2**	(1.04–1.47)	1.3**	(1.05–1.50)
35+	1.1	(0.84–1.50)	1.1	(0.83–1.51)
Parity				
1	ref.			
2	0.6***	(0.53–0.77)	0.6***	(0.50–0.74)
3	0.5***	(0.37–0.58)	0.5***	(0.38–0.61)
4+	0.4***	(0.31–0.50)	0.4***	(0.27–0.45)
Mother's education				
None	ref.			
Primary	1.01	(0.85–1.21)	1.0	(0.81–1.17)
Secondary or more	1.6***	(1.28–1.98)	1.6***	(1.29–2.03)
Socio-economic status				
Poorest	ref.			
Least poor	1.3***	(1.15–1.53)	1.3***	(1.13–1.51)
N	4355		4354	

Notes: ** $P < 0.01$; *** $P < 0.001$ 95% CI: 95% Confidence Interval.

age in the 2006–08 data using the Stata add-in for imputation by chained equations (ICE) (van Buuren *et al.* 1999; Carlin *et al.* 2003; Royston 2004; Royston 2005a; Royston 2005b).

Logistic regression models were run in Stata (version 10.1 for Windows) for the four outcomes of interest: visiting a facility for any antenatal care, visiting a facility four or more times for antenatal care, having a facility birth and having a skilled birth attendant (SBA) present during delivery. Using the 2004–05 data and the 2006–08 data, the two datasets were combined and a new variable ('timeframe') was generated to distinguish between the two surveys before and after launch of the OBA programme. We also fit two logistic regression models for the purchase and the use of voucher in the 2006–08 data.

As a falsification exercise, a chi-square test was conducted on NUHDSS time trends in the percentage of children 12–23 months who were reported to have received full vaccination each year from 2003 to 2009.

Findings

Tables 2, 3, 4 and 5 present results from multivariable logistic regression models. The primary study finding is that slum residents had a greater odds of having a facility delivery after

the OBA programme was launched. To test whether this positive finding was due to a shift from skilled home birth to facility birth, a second model was considered with 'skilled birth attendant present' as the outcome. We found that respondents also had significantly greater odds of having a SBA present after the programme was launched; suggesting the increase in facility-based deliveries exposed a greater proportion of women to SBAs rather than simply shifted those who would deliver at home with a SBA to a facility (Table 2).

Variables associated with a statistically significant increased odds of having a facility-based delivery include: being aged 24–34, having completed secondary education and being amongst the 'least poor'. Being located in Viwandani and being multiparous (2–4+ children) were statistically associated with lower odds of having a facility-based birth. The explanatory variables had the same association on odds of having a SBA delivery, although the relationships between some variables were of different magnitude.

Table 3 details the logistic models explaining purchase and use of a voucher for a facility-based delivery, using the 2006–08 data. Women less likely to purchase a voucher were those with four or more children and those classified as the 'least poor'. For voucher utilization, women located in Viwandani and women with three or more children were less likely to use a voucher.

Use of any antenatal care remained high in both surveys (Table 6) and women had similar odds of ANC visits in the first trimester, but women had significantly lower odds of completing four or more ANC visits in the OBA period (Table 4).

Table 3 Logistic regression results comparing use of voucher by demographic characteristics among respondents in the 2006–08 survey ($N = 2448$)

	Purchased a voucher		Used a voucher	
	Odds ratio	(95% CI)	Odds ratio	(95% CI)
Location				
Korogocho	ref.			
Viwandani	0.95	(0.76–1.18)	0.61	(0.36–1.03)
Mother's age at birth				
12–23	ref.			
24–34	0.87	(0.68–1.09)	1.12	(0.63–1.99)
35+	0.96	(0.62–1.47)	1.31	(0.47–3.67)
Parity				
1	ref.			
2	0.92	(0.72–1.18)	0.61	(0.32–1.18)
3	0.81	(0.60–1.09)	0.42**	(0.20–0.89)
4+	0.65**	(0.47–0.90)	0.31***	(0.13–0.70)
Mother's education				
None	ref.			
Primary	0.96	(0.77–1.20)	1.15	(0.67–1.99)
Secondary or more	1.02	(0.78–1.33)	1.30	(0.67–2.53)
Socio-economic status				
Poorest	ref.			
Least poor	0.80**	(0.64–99)	0.87	(0.52–1.45)
<i>N</i>	1860		845	

Notes: ** $P < 0.01$; *** $P < 0.001$.

In the OBA period (2006–08), women who purchased and used the voucher reported significantly much higher ANC utilization compared with women who did not purchase and who did not use the voucher (Tables 5 and 7).

Facility-based deliveries in Korogocho and Viwandani remained unchanged from 2003 to 2005 and then increased significantly from 2006 to 2009, the last available year for this analysis. To test whether other non-voucher health services also increased in the same period, immunization trends were compared from 2003 to 2009. Table 8 indicates that the proportion of children aged 12–23 months old who were fully immunized remained constant for the same time period that facility-based deliveries were increasing during the onset of the output-based voucher programme.

Discussion

The most important finding is the statistically significant increase in attended deliveries after the voucher programme was implemented. The significant increase in deliveries with SBAs indicates that the vouchers did not merely shift women who would deliver at home with a SBA to a facility. While claiming causality is difficult with the lack of comparable control areas that did not receive the voucher intervention, the finding of a positive association between programme launch and increases in facility deliveries is encouraging.

Another finding of note is that the voucher was more likely to be used by women in their first pregnancy. Women with higher parity had a lower odds of using a voucher, which may reflect preferences formed in previous deliveries. First births may be more difficult and experiences from the first delivery will influence choice of future delivery locations. As previously reported for non-voucher users in the same environment, presumably if a voucher mother has a positive experience at the

Table 4 Multivariate analysis of the vouchers programme and uptake of ANC

	Any ANC visit		4+ ANC visits		First ANC in 1st trimester	
	Odds ratio	(95% CI)	Odds ratio	(95% CI)	Odds ratio	(95% CI)
OBA programme (ref: before)						
After OBA programme	0.7 [†]	(0.5–1.0)	0.7***	(0.6–0.8)	0.8*	(0.6–1.0)
Slum (ref: Korogocho)						
Viwandani	1.0	(0.7–1.5)	1.5***	(1.3–1.7)	1.8***	(1.3–2.3)
Mother's age at birth (ref: age 12–24)						
24–34	1.7 [†]	(1.0–2.8)	1.4***	(1.2–1.6)	1.0	(0.8–1.4)
35+	1.2	(0.6–2.3)	1.3	(0.9–1.7)	1.5	(0.8–2.6)
Parity (ref: Parity 1)						
2	0.8	(0.4–1.5)	0.7***	(0.6–0.8)	0.6**	(0.4–0.8)
3	0.5 [†]	(0.2–1.0)	0.6***	(0.5–0.8)	0.6*	(0.4–0.9)
4+	0.2***	(0.1–0.4)	0.5***	(0.4–0.7)	0.5**	(0.3–0.8)
Mother's level of education (ref: none)						
Primary	1.2	(0.7–2.1)	1.3*	(1.0–1.8)	1.3	(0.7–2.5)
Secondary +	2.4*	(1.1–5.2)	1.7***	(1.3–2.4)	1.7	(0.8–3.4)
Socio-economic status (ref: poorest)						
Least poor	2.3***	(1.5–3.4)	1.4***	(1.2–1.6)	1.2	(0.9–1.6)

Notes: [†] $P < 0.10$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 5 Multivariate analysis of the association between vouchers and ANC uptake among mothers who did and did not receive vouchers in 2007–2008

	Any ANC visit		4+ ANC visits		First ANC in 1st trimester	
	Odds ratio	(95% CI)	Odds ratio	(95% CI)	Odds ratio	(95% CI)
OBA voucher (ref: did not receive)						
Received the voucher	16.5***	(4.0–68.1)	1.9***	(1.6–2.4)	1.2	(0.8–1.8)
Slum (ref: Korogocho)						
Viwandani	1.3	(0.8–2.3)	1.7***	(1.4–2.0)	1.9**	(1.3–2.9)
Mother's age at birth (ref: age 12–24)						
24–34	1.4	(0.7–3.2)	1.4**	(1.1–1.8)	1.3	(0.8–2.0)
35+	0.8	(0.3–2.1)	1.2	(0.8–1.9)	2.5*	(1.1–5.4)
Parity (ref: parity 1)						
2	0.7	(0.3–1.8)	0.7**	(0.5–0.9)	0.6*	(0.4–1.0)
3	0.4	(0.1–1.2)	0.5***	(0.4–0.7)	0.4**	(0.2–0.8)
4+	0.1***	(0.1–0.4)	0.6**	(0.4–0.8)	0.4**	(0.2–0.7)
Mother's level of education (ref: none)						
Primary	0.6	(0.2–1.8)	1.8*	(1.1–3.0)	1.4	(0.4–4.6)
Secondary +	1.9	(0.5–6.7)	2.0**	(1.2–3.5)	1.7	(0.5–5.9)
Socio-economic status (ref: poorest)						
Least poor	2.7**	(1.5–4.7)	1.1	(0.9–1.3)	1.0	(0.7–1.4)

Notes: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 6 Unadjusted odds ratios of five maternal care outcomes before and after the launch of the output-based approach voucher programme

	2004/05 baseline <i>n</i> (%)	2007/08 endline <i>n</i> (%)	Odds ratio (95% CI)
Any ANC visit	1858 (97.1%)	2348 (95.9%)	0.7 (0.5–1.0)*
4+ ANC visits	997 (52.1%)	1075 (43.9%)	0.7 (0.6–0.8)***
First ANC in 1st trimester	140 (7.3%)	166 (6.8%)	0.9 (0.7–1.2)
Facility-based deliveries	1238 (64.7%)	1759 (71.9%)	1.4 (1.2–1.6)***
Skilled birth attendant present	1337 (69.9%)	1813 (74.1%)	1.2 (1.1–1.4)**
Total number interviewed	1914	2448	

Notes: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

facility, she is more likely to seek a facility delivery for her next child (Bazant and Koenig 2009; Bazant *et al.* 2009).

In the results, it is evident that the smaller informal settlement, Viwandani, had significantly fewer deliveries and lower use of the voucher in spite of no significant difference in voucher sales. Additional research is needed to understand local characteristics that may affect voucher utilization. It is telling though that there were no significant differences in voucher sales, suggesting that security, lack of ambulance services, availability of public transport at night or other barriers may prevent mothers in Viwandani from seeking a facility delivery (Ziraba *et al.* 2009).

A final finding of note is that although all respondents were informal settlement residents, the 'least poor' were more likely to purchase the voucher, indicating a need to better target the poorest. Additional research is needed to determine what the barriers are to the poorest in the community. Perhaps the 200 Ksh voucher price was prohibitively costly or the poorest were not visited as regularly by voucher distributors, or they did not know many other mothers who used a facility and they did not see a need for a facility delivery.

It is important to acknowledge the limitations to this analysis. The most substantial limitation is the lack of contemporaneous controls in both surveys, which excludes this study from formal definition of an impact evaluation (Gertler *et al.* 2010). Without baseline controls, it is harder to rule out the possibility that the observed increases in facility-based births were due to something other than the voucher programme. Additionally, there is a possibility that an unobserved factor confounded the contrast in the 2006–08 follow-up survey between women who reported using the voucher to deliver at facility and similar pregnant women who did not use the voucher for delivery. For instance, it is possible that by chance the respondents who reported not using vouchers for their last delivery also lived in the most insecure parts of the slums and disproportionately began labour at night and could not leave home. In the absence of controls, the service utilization trend in immunizations of children aged 12–23 months was tested and found no significant increase year to year, suggesting that the increased proportion of facility-based deliveries was a service-specific phenomenon.

Table 7 Unadjusted odds ratios of five maternal care outcomes among women who received and did not receive the voucher in 2007–08

	Non-voucher users	Voucher users	Odds ratio (95% CI)
Any ANC visit	1591 (94.3%)	757 (99.5%)	11.4 (4.3–42.9)***
4+ ANC visits	660 (39.1%)	415 (54.5%)	1.9 (1.6–2.2)***
First ANC in 1st trimester	112 (6.6%)	54 (7.1%)	1.1 (0.8–1.5)
Facility-based deliveries	1030 (61.1%)	729 (95.8%)	14.5 (10.0–21.7)***
Skilled birth attendant present	1077 (63.8%)	736 (96.7%)	12.9 (8.9–19.3)***
Total number interviewed	1687	761	

Notes: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 8 Facility deliveries and vaccination coverage from NUDHSS, 2003–09

Measures	2003	2004	2005	2006	2007	2008	2009
Place of delivery							
House	27.2	22.1	28.1	26.5	18.6	20.5	15.8
Health facility	63.0	65.2	61.7	62.9	71.4	69.6	73.2
En route to health facility	0.5	1.7	1.7	0.9	1.0	1.0	0.7
% of children aged 12–23 months fully immunized							
Option 1 – card with dates	34.2	34.1	30.0	30.76	24.9	34.5	34.4
Option 2 – Option 1 + with card but no date	36.0	35.8	31.5	31.80	25.8	36.1	36.0
Option 3 – Option 1 + 2 + with no card but reported	42.1	49.9	46.0	50.60	36.3	51.2	51.1

External validity of these findings from an urban setting is limited. The Nairobi informal settlement environment presents different opportunities and challenges for the voucher programme compared with the rural areas. For instance, in Nairobi, the dense concentration of poor women within short distances of distributors facilitates voucher sales. However, the poor security situation at night, in particular, can impede access to facilities during early labour.

In spite of these limitations, the results of this research indicate that the output-based voucher programme is associated with increases in attended deliveries in the targeted Nairobi slums. While it remains to be seen whether the service is sufficiently cost-effective to scale nationally in Kenya, the voucher programme appears to be an effective mechanism to target low-income urban women and give them the financial means to overcome economic barriers to a facility delivery.

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Conflict of interest

None declared.

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