Effect of Performance-Based Financing on Health Service Delivery: A case study from Adamawa State, Nigeria

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Abstract

Background

Nigeria lags behind other African countries in terms of health outcome indicators, despite economic advantages. The poor health outcome indicators might be attributed to the poor service delivery. This paper evaluates the experimental effect of Performance-Based Financing (PBF) on service deliver indictors.

Methods

Nigeria State Health Investment Project (NSHIP), funded by the World Bank, was implemented in 3 Nigerian states between 2013 and 2018. Under NSHIP, some Local Government Areas (LGA) were randomly assigned to PBF intervention. We use Difference-in-Differences (DiD) to evaluate the effect of PBF on seven health service delivery indicators in Adamawa state.

Results

We find that PBF is highly effective in increasing the quantity of health service delivery. We observed that the PBF intervention significantly increased the quantity of most of the service delivery indicators more than the comparison group (Decentralized Facility Financing; DFF) did after the introduction of NSHIP, while the baseline level of the service delivery between PBF and DFF health facilities was statistically identical prior to the introduction of the intervention. We also conducted additional analysis for the robustness check to confirm the causal effect of PBF.

Discussions/Conclusions

Although we find the significant effect of PBF on most of service delivery outcomes, PBF did not have any impact on the quantity of full vaccination and postnatal care provided. Suggestive evidence shows that this insignificant effect is not due to the low unit price nor due to the high baseline rate. Future work should explore why PBF influenced some service delivery but not others.

Background

Although Nigeria is an economic giant in Sub-Saharan Africa (International Monetary Fund, 2019), it lags behind from many African countries in terms of health outcome indicators. For example, under-5 child mortality rate in 2017 is 100 per 1,000 live birth, which is one of the highest in the world (UN Inter-agency Group for Child Mortality Estimation, 2018). This low health outcome indicators can be attributed to low health service utilization. For example, the percentage of births assisted by a skilled birth attendant is merely 43 percent and the full immunization

coverage is 23 percent (National Bureau of Statistics (NBS) and United Nations Children's Fund (UNICEF), 2017).

Supply-side barriers such as unqualified health workers, staff absenteeism, inadequate staff, opening hours, and informal payments, are found to contribute significantly to the low level of the health service utilization (Adedini et al., 2014; Kyei-Nimakoh et al., 2017). Strengthening the health system can potentially improve the service delivery mechanisms, which can lead to the improved health outcomes.

One well-known way to improve the service delivery mechanism in health sector is to provide incentives to health service providers based on the performance; performance-based financing (PBF) (Musgrove, 2011). Many developing countries have been applying this innovative financing method to strengthen the health system to better delivery the health services to the target population (Eichler et al., 2013).

Basinga et al. (2011) studied one of the early programs on PBF in Africa, using randomized controlled trial. They found that PBF improved both the quantity and quality of maternal and child health service provision in Rwanda.

Our study evaluates the effect of the first PBF program implemented in Nigeria, which ran from 2013 through 2018.

Methodology

Nigeria State Health Investment Project (NSHIP):

With sponsorship from the World Bank, Nigerian government initiated the Nigeria State Health Investment Project (NSHIP) in 2012 with the general objective to improve the quantity and quality of the service delivery of primary healthcare. NSHIP was implemented in three states initially including Adamawa, Nasarawa, and Ondo state.

Under NSHIP, two different payment schemes were implemented to evaluate their effectiveness on the service delivery. One is Performance-Based Financing (PBF) scheme, and another is Decentralized Facility Financing (DFF) scheme.

Under PBF, health facilities (HFs) received a quarterly payment based on the quantity of services delivered. For detailed information on the incentives, see Kandpal et al. (2019). The type of services which is the basis of the payment was pre-determined. The example of the type of services is outpatient consultation, complete vaccination cases, tetanus-toxoid vaccination of pregnant women, postnatal care consultation, antenatal care consultation, family planning service, and institutional delivery. Each health facility is assigned to the unit price for each type of service provided. The monetary incentives are based on the quantity of services provided, multiplied by the unit price.

On the other hand, under DFF, health facilities received a certain amount of payment, regardless of the quantity of services delivered. Health facilities under DFF could earn half the amount of what PBF could earn.

In Adamawa state, which is the study site of the paper, the treatment was randomly assigned to each Local Government Area (LGA). Adamawa state has 21 LGAs, 11 of which received PBF and the remaining 10 received DFF. The total number of health facilities which received either PBF or DFF was 445. There are in total of 947 health facilities recoded in data portal called District Health Information Software 2 (DHIS2). We will discuss more about the data in the Data section. About half of health facilities in Adamawa state did not receive either PBF or DFF and operated "business as usual"; thus they were in Control group. Health facilities in Control group were those which did not have sufficient level of functionality in terms of infrastructure and personnel. Figure 1 presents the research design. NSHIP has been in operation in most of health facilities in Adamawa from January 2013 till 2018 August.

Data:

We use the health-facility level data collected by the Health Management Information System through the District Health Information Software 2 (DHIS2). The DHIS2 data record monthly information on the quantity of various health services provided from all the health facilities in Adamawa state, Nigeria before and after the introduction of NSHIP.

To identify health facilities in each category, PBF, DFF, and Control, we compare two sets of the list of health facilities. One is the census list of all the health facilities existent in Adamawa state, which we obtained from DHIS2 data. Another data source is the restricted list of health facilities, either PBF or DFF, that is publicly available online (National Primary Healthcare Development Agency, 2019). If a health facility in DHIS2 data is not listed in the restricted data from PBF portal, which means that the health facility did not receive PBF nor DFF, thus they are Control HFs.

Outcomes:

We focus on seven outcomes on health services. All the outcomes are measured in the quantity; how many times each health facility provided a particular health service per month. Our seven health services indicators include antenatal care (ANC), normal delivery, delivery services by skilled personnel, full vaccination among children, outpatient, postnatal care (PNC), and the third-dose of tetanus-toxoid vaccination (TT3). For each outcome, we have the information for each health facility for a particular month of the year.

Statistical Analysis:

Using the DHIS2 data for health facilities, we causally evaluate the effect of the PBF intervention on the quantity of various health services provided at health facilities.

To do so, we employ the Difference-in-Differences (DiD) approach. First, we compare the change in the outcome variables between PBF health facilities (PBF HFs) and DFF health facilities (DFF HFs), before and after the introduction of NSHIP in the following regression framework;

$$y_{it} = \alpha + \beta_1 PBF_{it} + \beta_2 After_{it} + \beta_3 PBF\_After_{it} + v_i + \varepsilon_{it} \qquad (1)$$

where y_{it} is an outcome variable, service provision at health facility *i* at time *t*; PBF_{it} is a dummy variable which indicates if the health facility is assigned to PBF treatment (PBF HFs). The comparison group is health facilities under DFF (DFF HFs). $After_{it}$ is a dummy variable which indicates if NSHIP has been introduced to health facility *i* at time *t*; PBF_After_{it} is an interaction term between *PBF* and *After*. We use the LGA fixed effect, *v*, to control for LGA-specific characteristics. Because the assignment of the treatment (PBF or DFF) is at the LGA level, once we introduce the LGA-level fixed effect, the variable PBF_{it} is dropped from the analysis due to the perfect multicollinearity.

The main analysis compares the effectiveness of PBF intervention, as compared to DFF, on various outcomes, restricting the sample to health facilities that are assigned to either PBF or DFF; eliminating Control health facilities that had not been assigned to either group.

β_1 identifies differences between PBF HFs and DFF HFs before the introduction of NSHIP. However, as mentioned above, with the LGA fixed effect, β_1 is dropped automatically with LGA fixed effect. β_2 identifies the time trend after the initiation of NSHIP among DFF HFs, as compared to before the NSHIP introduction. β_3 is the coefficient of our interest. It captures the difference-in-differences estimator of the effect of PBF. This DiD estimation strategy is valid only under the assumption that the time trend of outcome would have been the same between PBF HFs and DFF HFs in absence of NSHIP intervention.

We hypothesize that PBF program improved the service delivery more than DFF program. In other words, we expect $\beta_3 > 0$.

Second, we evaluate the effectiveness of PBF intervention by comparing PBF HFs and Control HFs. Because the assignment of the treatment, either PBF or DFF, was done at LGA level, we focus only on PBF LGAs. We use the same identification strategy as the equation (1) with LGA fixed effect with Control HFs being the comparison group. In this analysis, β_1 would not drop because there is a variation in the treatment assignment, either PBF or Control, within each health facility.

Finally, to confirm the rigorous causal effect of PBF intervention, we conduct a pacebo test. Using the same equation as (1), we evaluate the difference in the provision of health services between health facilities in control group (Control HFs) within PBF LGAs and health facilities in control group (Control HFs) within DFF LGAs. In absence of NSHIP, heath facilities in PBF LGAs should have similar characteristics as ones in DFF LGAs, unless they are systematically different. If the randomization at LGA level worked well, we expect that β_3 is not different from zero.

Results

Out of 947 health facilities in Adamawa state, 932 facilities are used for the analysis. The remaining 15 health facilities do not have sufficient data to be included in the analysis.

Table 1 presents the baseline level of health services provision according to the intervention status; PBF HFs, DFF HFs, and Control HFs before the introduction of NSHIP. Table 1 column 1 presents

the overall average quantity of service delivery. On average, each health facility provides about 53 antenatal care services per month, 11 normal delivery services, and 10 delivery services by skilled personnel. The average monthly full vaccination cases in each health facility is 20. The average outpatient cases is 127, the average number of postnatal care services is 23, and the third dose of tetanus-toxoid is given 6 times on average in each health facility.

Table 1 columns 2 to 4 present the average quantity by the treatment status (PBF, DFF, and Control), and column 5 presents the differences in the baseline service delivery between PBF HFs and DFF HFs. We find that all the seven outcome indicators are balanced. None of the difference of outcome variables at baseline is significantly different between PBF and DFF HFs.

Table 1 column 6 presents the difference in the quantity of service delivery between Control HFs and PBF HFs. Unlike the comparison between PBF HFs and DFF HFs, we find the significant difference in outcome indicators between PBF HFs and Control HFs. The baseline health service provision is generally more among PBF HFs than among Control HFs. PBF HFs provides 24 cases more ANC, 5 more cases of delivery service, 3 more cases of delivery assistance by skilled personnel, 4 more cases of full vaccination provision, 83 more outpatient cases, and 2 more cases of the third dose tetanus-toxoid. This observation is consistent with the selection criteria to NSHIP; Control HFs were those which did not have sufficient level of functionality in terms of infrastructure and personnel.

Figure 2 presents the trend in the quantity of the service provision over time, separately among PBF HFs, DFF HFs, and Control HFs. The horizontal axis shows the time. At Time = 0, NSHIP was introduced at each LGA where HFs belong to. The timing of the NSHIP introduction differs by each LGA. Any time before Time=0 is the pre-intervention period. We observed that the time trend of the quantity of service provision among PBF HFs and among DFF HFs was mostly balanced in Table 1 (column 5), while the quantity was significantly lower among Control HFs (Table 1 column 6). These time trends prior to the introduction of NSHIP can also be observed in Figure 2 before Time = 0 for most of the variables.

Immediately after the introduction of NSHIP, the quantity of most service provisions under PBF HFs increased more than the one under DFF HFs and under Control HFs. The exception is the full vaccination cases. Although the number of full vaccination cases seems much more under PBF HFs than under Control HFs, it does not seem much different from the one under DFF HFs.

Table 2 presents the main result. We evaluate the effect of PBF intervention on various health services provision, by comparing PBF HFs and DFF HFs using DiD approach. We find that, for five main outcomes out of seven, PBF intervention significantly increases the quantity of service provision, as compared to DFF, after the introduction of NSHIP. The number of ANC cases increases by about 30 cases under PBF HFs as compared to DFF HFs; the number of normal delivery by 12 cases; the number of delivery by skilled personnel by 18 cases; the number of outpatient by 106, and the number of the 3rd dose administration of tetanus-toxoid by 8 cases.

We also find that, among DFF HFs, the quantity of some service provision, such as ANC, normal delivery, full vaccination, and outpatient, also significantly increases after the introduction of NSHIP (Table 2).

Table 3 presents the effect of PBF intervention, by comparing PBF HFs and Control HFs ("business as usual"). In this analysis, we focus only on PBF LGAs and evaluate the effect of PBF on the service provision by comparing PBF HFs and Control HFs. We find that the PBF intervention induced the increase in the quantity of the service provision for five indicators out of seven in PBF HFs as compared to the control HFs. For example, after the introduction of PBF program, the number of ANC increased by 33 under PBF HFs more than that under Control HFs; the number of delivery assistance by skilled personnel by 9, the number of full vaccination cases increased by 5, outpatient by 80, and the number of the third dose of tetanus-toxoid by 3.

Table 4 presents the result of placebo test. We test whether health facilities in PBF LGAs and DFF LGAs would have had different characteristics over time in absence of NSHIP, by comparing Control HFs in PBF LGA and Control HFs in DFF LGAs. Overall, we find that, the effect of NSHIP program on any of the indicators of service provision is not significantly different between control HFs in PBF LGAs and control HFs in DFF LGAs. This insignificant result among Control HFs strengthens the argument that the significant increase in the quantity of service provision among PBF HFs we observed in Table 2 is due to the introduction of PBF intervention.

Discussions

This paper evaluates the causal effect of Performance-Based Financing (PBF) on the quantity of service delivery in one of the northeastern Nigerian state, Adamawa. Nigeria, especially northern Nigeria, observe the low level of health service utilization, as compared to the international and national level (Atlas of African Health Statistics, 2018; National Population Commission (NPC) [Nigeria] and ICF International, 2014). One potential barrier to the access to health services is the weak health system, which leads to the weak service delivery. PBF is an innovative scheme to strengthen the health system with the objective of improving the quantity and quality of health service provision by incentivizing the health personnel to achieve the improved level of the performance of health facility.

This paper demonstrates one of the first evidence of the effectiveness of PBF intervention in northern Nigeria by evaluating the randomized PBF intervention, financed by the World Bank. The assignment of the treatment, PBF intervention, was random at LGA level. Our balance tests proved that this randomization was indeed successful.

Overall, we find that PBF is highly effective in increasing the quantity of health service delivery. We observed that the PBF intervention significantly increased the quantity of most of the service delivery indicators more than DFF did after the introduction of NSHIP, while the baseline level of the service delivery between PBF and DFF health facilities was statistically identical prior to the introduction of the intervention.

We also confirm the causal positive effect of PBF by comparing outcomes among PBF HFs and Control HFs within PBF LGAs. Our placebo test reassures that the increase in the quantity of service provision is due to the introduction of PBF.

Among seven indicators, PBF interventions did not induce the significant increase in the number of cases of full vaccination and that of postnatal care, as compared to DFF intervention. In northern Nigeria, the full immunization and the postnatal care are both extremely limited. For example, only 20 percent of children in northeastern Nigeria completed the full vaccination schedule, while children in southern Nigeria completed more than 40 percent (National Immunization Coverage Survey (NICS), 2018). The rate of postnatal care visit in northeastern is merely 34.3 percent, while the southern regions achieve more than 65 percent (National Population Commission (NPC) [Nigeria] and ICF International, 2014).

Because both full immunization and postnatal care are considered critical to reduce the maternal and child health burdens (World Health Organization, 2014; Andre et al., 2008), it is important to investigate further the potential reasons why PBF intervention did not influence the full vaccination cases and postnatal care. Basinga et al. (2011) explained that the low unit price for the service delivery causes the insignificant effect of PBF intervention. However, the average unit price for the full vaccination is about 1454 naira (1 USD = 360 Naira as of 2019 June) and the price for the postnatal care is 394 naira (Table 5). These unit prices are not as low as that of antenatal care (294 naira) and of third dose of tetanus-toxoid (197), which respectively we found the strong positive effect of PBF.

Basinga et al. (2011) also mentioned that if the baseline immunization rate is already high, then there is little room for the improvement. However, as explained above, both the full immunization rate and postnatal care visit is extremely limited in northern Nigeria. Future study should explore more on reasons why PBF intervention did not impact the full immunization rate and postnatal care service.

Despite of strong evidence of the effective PBF intervention, there is some concern on the sustainability of PBF intervention. Although we observe that the quantity of service provision increased right after the introduction of PBF, the quantity of many service delivery, such as the number of child delivery, outpatients, postnatal care, and the third dose of tetanus-toxoid, decreased toward the end of the intervention (Figure 2). This inverted-U relationship between the time since the intervention introduction and the quantity of service provision poses some questions on the sustainability of the PBF intervention. Future work should explore the reasons of this inverted-U relationship.

Another concern is that PBF intervention might have increased the quantity of service provision by sacrificing the quality of the service provision per unit, especially if the resource is constrained. On the other hand, because personnel at health facilities under PBF scheme needs to attract patients for utilizing the service, it is rational that health personnel treat patients better than under no PBF intervention. PBF might have improved the quality of service provision and might have enhanced the patients' satisfaction. In this study, the data does not allow us to examine the effect of PBF intervention on the quality of service delivery including the patients' satisfaction. However, Kandpal et al. (2019) found that PBF intervention in Nigeria led to the significant improvement in the quality indicators of service delivery such as reduced stockouts of commodities and health staffs' knowledge.

Conclusions

This paper evaluates the causal effect of Performance-Based Financing (PBF) on the quantity of service delivery in Adamawa state, Nigeria. We find that PBF is highly effective in increasing the quantity of health service delivery. The full immunization and postnatal care cases did not increase due to PBF. Future work should explore why PBF was effective in increasing some service delivery but not others.

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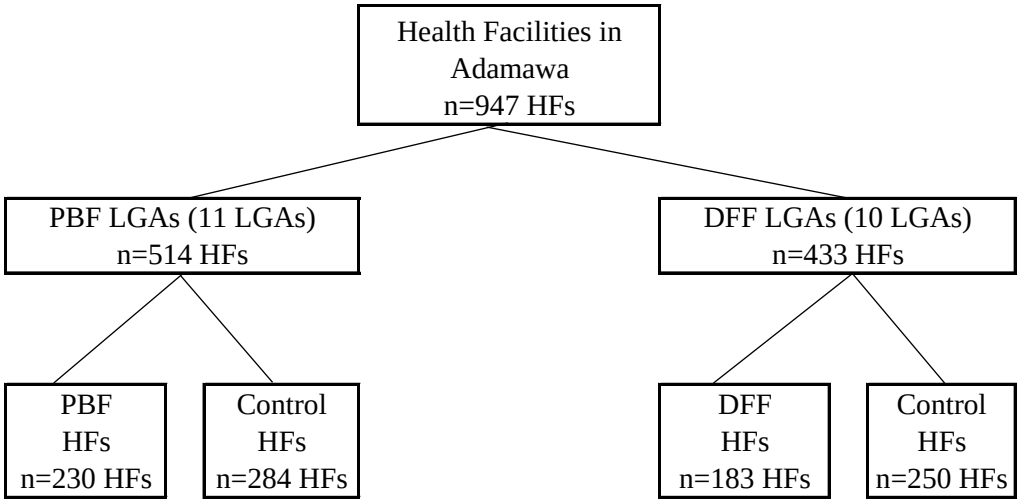
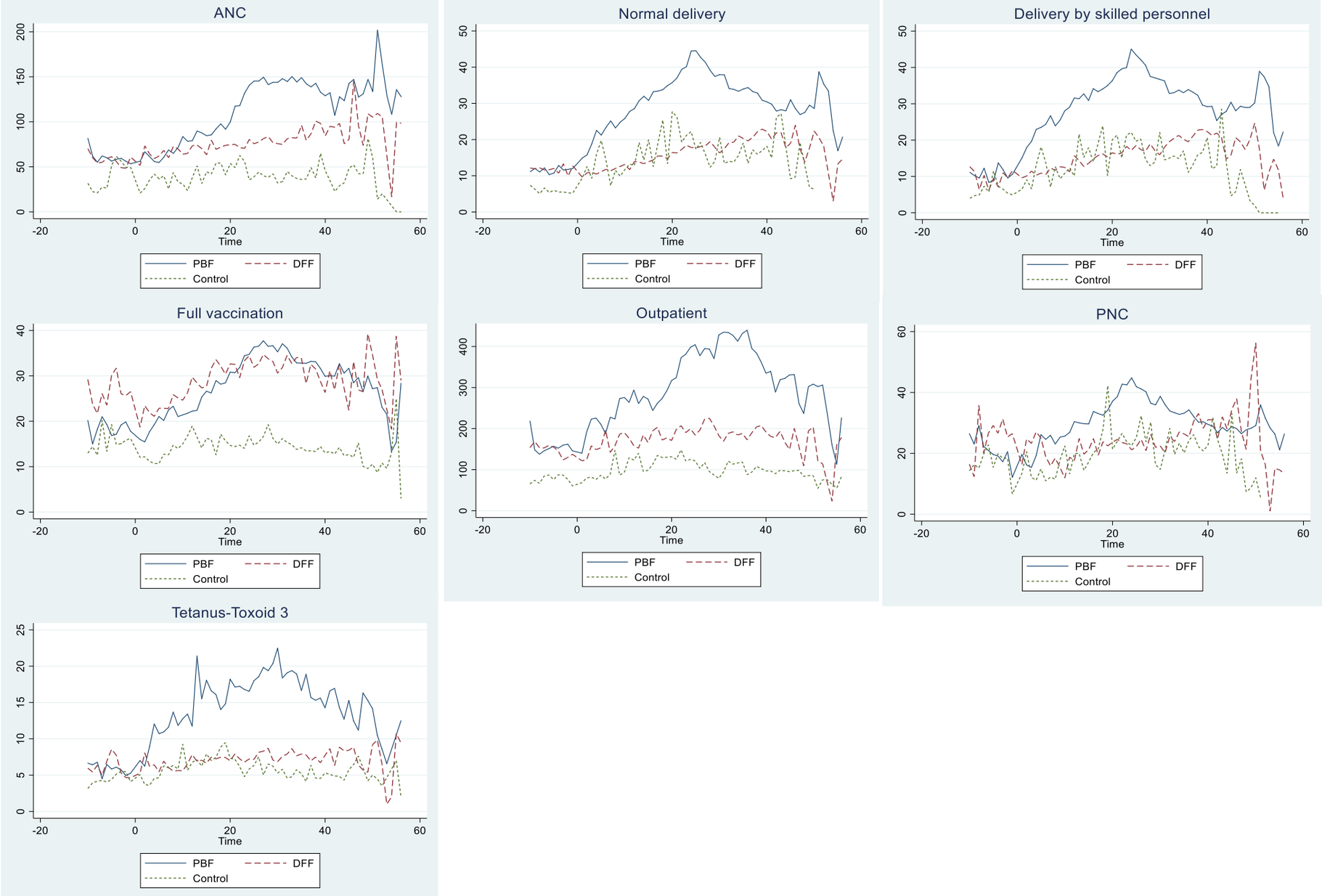
Figure 1: Research Design



Notes: HF stands for health facility.

Figure 2: Time Trend of Health Service Delivery (PBF vs. DFF)



Notes: The total number of health facilities for the analysis is 932. The sample includes health facilities that are either PBF HFs, DFF HF, or Control HFs. Time = 0 indicates the introduction of NSHIP in each LGA.

Table 1: Baseline Health Service Delivery

	ALL	PBF	DFF	Control	Difference (std err) PBF vs. DFF	Difference (std err) PBF vs. Control
	(1)	(2)	(3)	(4)	(5)	(6)
ANC	52.810	59.45311	62.596	34.99721	-3.143 (10.545)	24.456 (12.294)*
Normal Delivery	11.469	12.23677	13.16496	6.820569	-0.928 (1.856)	5.416 (1.276)***
Delivery by Skilled Personnel	10.285	9.898	12.94962	6.423077	-3.052 (2.321)	3.475 (1.628)**
Full Vaccination	19.640	19.274	24.66513	15.03207	-5.391 (3.314)	4.242 (2.029)*
Outpatient	127.132	158.023	152.4283	75.77095	5.595 (22.574)	82.252 (15.749)***
PNC	23.397	23.291	26.41894	19.38107	-3.128 (7.865)	3.910 (3.872)
Tetanus-Toxoid 3	6.016	6.803	6.44358	4.658333	0.359 (1.134)	2.144 (1.033)*

Notes: The total number of health facilities for the analysis is 932. The sample includes health facilities that are either PBF HFs, DFF HF, or Control HFs. The difference is with LGA clustered standard error. *Significant at 10%, **significant at 5%, and ***significant at 1%.

Table 2: Effect of PBF on Health Service Delivery

	ANC	Normal Delivery	Delivery by Skilled Personnel	Full Vaccination	Outpatient	PNC	Tetanus-Toxoid 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LGA = PBF	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)
After	14.200*	5.504**	2.522	5.944***	32.177**	-2.164	0.634
	(7.332)	(2.299)	(1.938)	(1.303)	(13.515)	(4.767)	(0.748)
PBF * After	29.891***	12.386***	17.759***	3.800	105.904***	9.927	8.367***
	(8.969)	(2.664)	(2.481)	(2.634)	(24.453)	(5.821)	(1.735)
Constant	65.976***	13.162***	12.561***	21.649***	167.292***	24.787***	6.578***
	(3.739)	(1.109)	(1.122)	(1.214)	(11.061)	(2.478)	(0.827)
N	16999	15688	14039	14938	16971	13648	9450
r2	0.014	0.006	0.040	0.008	0.017	0.003	0.028

Notes: The sample includes health facilities that are either PBF HFs or DFF HF, excluding control HFs. The comparison group is LGA under DFF. The analysis controls for LGA fixed effect, with LGA clustered standard error. *Significant at 10%, **significant at 5%, and ***significant at 1%.

Table 3: Effect of PBF on Health Service Delivery (Robustness: PBF vs. Control in PBF LGA)

	ANC	Normal Delivery	Delivery by Skilled Personnel	Full Vaccination	Outpatient	PNC	Tetanus-Toxoid 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
HF = PBF	35.956***	10.632***	6.476*	8.197***	124.749***	5.678	4.401***
	(8.170)	(2.506)	(3.473)	(1.756)	(27.704)	(5.405)	(1.356)
After	-4.956	5.276**	-2.970	-1.160	9.048	-3.023	1.473
	(4.765)	(2.298)	(3.434)	(1.091)	(25.059)	(4.825)	(1.078)
PBF * After	33.171***	1.934	8.686*	4.504***	80.499***	4.393	3.154**
	(7.775)	(2.461)	(3.977)	(1.111)	(23.039)	(4.011)	(1.343)
Constant	42.740***	11.636***	17.511***	15.859***	97.896***	23.791***	5.432***
	(8.252)	(2.437)	(3.106)	(1.791)	(25.696)	(6.128)	(1.377)
N	13176	11156	10463	13083	15815	10394	7469
r2	0.083	0.052	0.061	0.085	0.119	0.014	0.050

Notes: The sample includes health facilities that are in PBF LGA, either PBF HFs or control HFs. The comparison group is control Health Facilities. The analysis controls for LGA fixed effect, with LGA clustered standard error. *Significant at 10%, **significant at 5%, and ***significant at 1%.

Table 4: Effect of PBF on Health Service Delivery (Placebo Test: among Control HFs)

	ANC	Normal Delivery	Delivery by Skilled Personnel	Full Vaccination	Outpatient	PNC	Tetanus-Toxoid 3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LGA = PBF	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)
After	-12.659	3.540	4.939	-0.155	13.015	2.064	0.516
	(22.778)	(2.795)	(5.552)	(1.835)	(19.098)	(2.763)	(0.546)
PBF * After	13.626	3.939	3.113	0.078	-10.290	-4.286	1.016
	(23.113)	(3.182)	(5.949)	(2.861)	(24.107)	(5.891)	(1.242)
Constant	42.276***	9.324***	7.069**	14.300***	91.840***	19.574***	4.689***
	(10.166)	(1.334)	(2.905)	(1.277)	(9.867)	(2.360)	(0.491)
N	5480	2589	2495	6673	8170	2363	2755
r2	0.001	0.005	0.004	0.000	0.000	0.000	0.003

Notes: The sample includes health facilities that are only control HFs, excluding PBF HFs and DFF HFs. The comparison group is LGA under DFF. The analysis controls for LGA fixed effect, with LGA clustered standard error. *Significant at 10%, **significant at 5%, and ***significant at 1%.

Table 5: Average unit price (naira)

	Mean	sd	min	max
ANC	293.5	89	110	585
Normal delivery	2953.7	864	936	4066
Full vaccination	1454.4	461	360	2033
New outpatients	99.8	27	50	135
PNC	394.3	115	180	542
TT	197.0	58	45	271

Notes: The unit price is the average price among the available (n=221) PBF HFs in Adamawa state in DHIS2 data.