Original Article

Exploratory study estimating the impact of performance-based financing (PBF) on quality of care and on the contextual factors mediating the effectiveness of PBF in improving quality of care in Zimbabwe

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Background: Ensuring value for health sector spending is a universal concern for policy makers in low- and middle-income countries (LMICs), where health care demands are rising and health sector financing is limited. Performance-based financing (PBF) is more frequently being implemented in LMICs to improve quality of care and ultimately health system outcomes. Through PBF, LMICs can potentially reduce variation in clinical practice, because PBF provider incentives are directly linked to achievement of predefined quality of care standards and adherence to quality protocols. Zimbabwe implemented PBF in 16 districts as a health system reform to improve the quality and coverage of health services from 2011. This paper first estimates the impact of PBF on quality of care, and then explores contextual factors mediating the effectiveness of PBF in improving quality of care in Zimbabwe.

Methods: The World Bank collected household and health facility data in 2010/2011 and 2014 (baseline and end line years, respectively). Thirty-two districts served as the total study sample for the impact evaluation, comprising 16 PBF pilot districts and 16 comparison districts. These 32 districts were purposively sampled out of Zimbabwe's 64 districts and then pair-matched on the basis of observable information described below. The pair-matching process sought to improve the power of inference and provide balance on observable district and facility characteristics. Two datasets were merged and then analyzed, one with household information and the other with health facility and health worker information. Pairing of households with health facilities was done at the community level. Baseline imbalances were adjusted for by difference-in-difference (DID) regression analysis. Contextual factors were analyzed to determine the most influential factors. Quality of care was measured for antenatal care (ANC), extended program on immunization (EPI), institutional deliveries, curative care, and postnatal care (PNC) services. A composite quality of care index was created using these five health services.

Results: Overall, PBF was found to have no effect on quality of care for services, except for institutional deliveries. PBF improved quality of institutional delivery by 0.01 percentage points. Results of individual contextual factors on their impact of PBF on quality of care were varied. An increase in the distance between health facilities and communities decreased the impact of PBF on quality of care by about 1.21% (P=0.0020), while distance from the district capital had no impact on PBF effects on quality of care. The size of the catchment area, mean population wealth, and availability of skilled health workers had no impact on PBF effects on quality of care. However, health workers' job satisfaction increased the impact of PBF on quality of

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care by 27.7% (P<0.0001).

Conclusions: Evaluations of complex health system reform interventions such as PBF need to go beyond exploring effects on priority health outcomes. As a strategic purchasing tool, PBF design should be informed by a country's contextual factors. At the same time, evidence on contextual factors outside the control of policy makers and the health system—such as mean population wealth—must be better understood and documented.

Keywords: Result-based financing; performance-based financing (PBF); low- and middle-income countries (LMICs); contextual factor; quality of care

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Introduction

Ensuring value for health sector spending is a universal concern for policy makers in low- and middle-income countries (LMICs), where health care demands are rising and health sector financing is limited. In the context of implementing strategies and interventions to achieve Universal Health Coverage (UHC) and ultimately Sustainable Development Goals (SDGs) by 2030, value for health sector spending is critical. For LMICs to achieve the third health SDG[1], improved access to high quality health care is imperative (1).

An array of concepts and definitions constitute quality of health care. The two most prominent are: (I) the Donabedian framework of structure, process, and outcome quality; and (II) the Institute of Medicine's (IOM) six dimensions of quality (IOM Board on Health Care Services, 2001). While Donabedian defines quality of care as the final output of processes and structures within health care delivery systems (Das *et al.*, 2016), the IOM's definition of quality in health care is linked to the extent to which health outcomes in a population are consistent with professional knowledge of health care standards (2).

To improve health care quality, and at the same time achieve value for money in health financing, high income countries and LMICs have initiated various reforms, including health insurance, prepayment schemes, and provider payment mechanisms (3). Performance-based incentives for health involve cash or nonmonetary payments or rewards transferred to a national or subnational government, manager, provider, payer, or consumer of health services after predefined results have been attained and verified (4). Performance-based incentives encompass various forms of incentives for health systems and households; LMICs and Organization for Economic Cooperation and Development (OECD) countries are turning to this approach to improve health system performance (5). At least 34 performance-based incentive hospital schemes were active in 14 OECD countries in 2017, and between 2004 and 2015, and at least 30 LMICs were at various stages of piloting and scaling up performance-based incentive schemes (4).

The underlying rationale is that performance-based financing (PBF) can extrinsically motivate health providers through incentives. By financially rewarding improvements in quality of health care, health providers will make greater efforts to achieve better results (3). As such, PBF is a core component of strategic purchasing of health services in a growing number of LMICs. Strategic purchasing helps link resources for health to the effective delivery of quality services (6).

Through PBF, LMICs can potentially reduce variation in clinical practice because provider incentives are directly linked to the achievement of predefined quality of care standards and adherence to set protocols (7). PBF programs can provide direct incentives for quality, or through payment formulas that combine quantity and quality indicators that determine payments made to

[1]This SDG (Ensure healthy lives and promote wellbeing for all at all ages) addresses all major health priorities, including: reproductive, maternal, and child health; communicable, non-communicable, and environmental diseases; universal health coverage; and access for all to safe, effective, quality and affordable medicines and vaccines.

health providers (1,8). In addition to financial incentives, PBF programs combine financial incentives with quality assurance and increased health provider supervision (4). Payments from PBF programs increase or decrease based on regularly aggregated scores (i.e., monthly, quarterly, or bi-annually) from a quality of care checklist agreed upon in advance by stakeholders.

Evidence on the effects of PBF on quality of health care in LMICs is limited, but growing. Evaluations in Rwanda, Argentina, Cambodia, Tanzania, and Zambia illustrate PBF's potential for improving coverage and quality of health services (9-13). Yet in some LMIC settings, PBF has demonstrated mixed results.

Given that PBF is a complex health systems reform intervention, it is essential to understand not only PBF's effects on outcomes, but also underlying contextual factors that might blunt or amplify the effectiveness of PBF on quality of health care outcomes in LMIC settings.

To date, there is no empirical evidence on effects of contextual factors on PBF's impact on quality of care (9,14,15). Program performance on quality of care may be influenced by many factors. These factors include population characteristics, such as population mean education or wealth. Existing evidence has shown that access to life-saving maternity health services can be hindered by the cost of accessing health services and the willingness of the population to access these services. In 2012, Sila *et al.* found that among rural women in South Africa, household wealth, geographic location, and staff attitudes were major determining factors in women delivering in health facilities (16). Distance to health facilities deterred women from seeking maternity services; women who stayed furthest from health facilities were least likely to deliver in health facilities. A similar finding in Kenya found that distance to health facilities and socio-economic status significantly influenced women's decisions on institutional deliveries (17).

Availability of maternal health services is determined by availability of skilled staff to deliver these services. However, improved staff attitudes towards clients also improve quality of health services, which in turn increases acceptability and use of these services. Women who experience negative staff attitudes are less likely to use health services. Health workers who are not satisfied with their jobs are more likely to have negative attitudes towards clients. While varied implicit and explicit factors are linked to health workers' job satisfaction, the most notable and consistent factors are related to health workers' satisfaction with their remuneration (18,19).

Population density has long been linked to health service access. Health facilities located in highly populated areas are more likely to have more people access their services than health facilities in areas where the catchment population is low (20).

This paper is an exploratory study estimating the impact of PBF on quality of care and the contextual factors mediating the effectiveness of PBF in improving quality of care in Zimbabwe. Our analysis was guided by a conceptual framework for how PBF, as a strategic purchasing tool, influences the behaviors of health providers and other key health system stakeholders towards improved health outcomes (21). The study uses quantitative data from two rounds of household surveys and two rounds of health facility surveys in Zimbabwe, an LMIC that introduced PBF in 2011. Given the paucity of evidence on PBF's effect on health services and health outcomes, this study empirically tests the effect of PBF on quality of care. In addition, the study explores how contextual factors affect PBF's effects on quality of care outcomes in an LMIC context, Zimbabwe, through a quasi-experimental evaluation.

Study context

According to the World Health Organization (WHO) 2010 country burden of disease profile, at least three-quarters of annual deaths in Zimbabwe can be attributed to communicable, maternal, perinatal, and nutritional illness (6). Once a regional beacon of economic and human development, Zimbabwe sank into a decade-long economic crisis in the late 1990s. Zimbabwe's socioeconomic collapse destabilized the pillars of the country's health sector: human resources for health, pharmaceutical and equipment supplies, health care financing, and service delivery. Health indicators and outcomes deteriorated, and Zimbabwe fell behind its sub-Saharan African peers on progress toward Millennium Development Goals (World Bank 2015). Quality of health care declined, as evidenced by several household and facility surveys showing major deficits in the quality of ambulatory and hospital health care services [Zimbabwe Demographic and Health Surveys (ZDHS) 2005 and 2009; a study by the USAID's Maternal and Child Health Integrated Program 2012; and the National Integrated Health Facility Assessment of 2012]. In 2015, Zimbabwe's maternal mortality ratio (MMR) was at 614/100,000 live births and the infant- (IMR) and under-five mortality rates (U5MR) were 45/1,000 live births and 75/1,000 live births respectively (22). Further, Zimbabwe

has a high rate of neonatal deaths, the majority of which occur in the first 24 hours postpartum because of preterm birth complications, birth asphyxia, and neonatal sepsis. These poor outcomes are in many ways linked to the poor quality of care.

Methods

In July 2011, the Government of Zimbabwe (GOZ)—through the World Bank's Health Sector Development Support Project—rolled out a PBF program to improve the quality and quantity of health services provided by health facilities in selected districts. The PBF project introduced a fee-for-service scheme for the delivery of a package of high-impact MCH services. The GOZ and the World Bank collected data in 2010/2011 and 2014 (baseline and end line years, respectively) from facilities and households in the surrounding catchment area to monitor health-related outcomes. The intervention is described in more detail in Appendix I.

Selection of PBF intervention and control areas

Thirty-two districts served as the total study sample for the impact evaluation, comprising 16 PBF pilot districts and 16 comparison districts. These 32 districts were purposively sampled from the population of 64 districts in Zimbabwe and then pair-matched on the basis of observable information described below. The pair-matching process sought to improve the power of inference and provide balance on observable district and facility characteristics. One district in each pair was allocated to the PBF and the other district to the control (business-as-usual) by the MOHCC. The district matching process considered the following characteristics: geographic accessibility—i.e., ruralness and remoteness—type and level of health facilities, average facility catchment population, proportion of staff in position, presence of key staff such as the District Medical/Health Officer, health services utilization rates for antenatal and postnatal care (PNC) coverage, and institutional delivery and immunization rates for 2008, 2009, and 2010.

For pair-matching of districts, all indicators were combined into one index through principal component analysis; this index was then organized into quintiles. Within each province, two districts from the top (high capacity) and two from the bottom (low capacity) of the index score derived from these measures were selected. Zimbabwe MOHCC leadership then purposively selected one of the two districts in each matched pair to receive the PBF intervention. Thus, the identification strategy for the impact evaluation is a quasi-experimental difference-in-differences (DID) estimator applied within these matched pairs.

In this paper, we aim to objectively (I) estimate the effect of PBF on quality of care; and (II) identify contextual factors that mediate the influence of PBF on quality of care measures.

Study design

The study used a quasi-experimental research design to evaluate the impact of PBF on utilization of key health services. The study utilized 116 enumeration areas (EA) used in the ZDHS. These EAs were drawn from census files. The study covered rural health centers in intervention and control districts.

The baseline and end line surveys were conducted in both treatment and control health facilities. However, for household surveys, data was not collected during the baseline survey and data from the 2010–2011 ZDHS was used in lieu of a formal, separate sample.

Sampling

The analysis made use of secondary data obtained from household and health facility datasets. The first dataset contained information on households and health facilities, while the second dataset contained information on health workers. The two datasets were merged to allow for comprehensive analysis on contextual factors.

When matching health facilities to households, two assumptions were made: (I) communities use the health facilities nearest to them (i.e., the "nearest neighbor" assumption); and (II) households are less likely to seek health services in an administrative district different from the one in which they reside. As such, households near district borders were assigned to health facilities within their district.

Pairing of households to health facilities was done at the community level. Appendix II provides the detailed pairing methodology. Communities without location details (i.e., that were not captured at the time of the survey) were excluded from the matching. The final dataset covered 22 districts, i.e., 11 districts as the PBF group and 11 districts as the control group, across eight provinces. A sample of 1,104 pregnancies were used for the analysis and a total of 55 communities were included in the analysis.

Dataset

In this dataset, each row of data represented a woman who had a birth in the two years preceding the survey. Quality of care was measured through recalls by women who had a pregnancy-related outcome over the past two years, health worker interviews focusing on core quality protocols for maternal, newborn, and childcare, and direct observations of specific maternal and newborn clinical care procedures. Participants were asked a series of dichotomous (yes/no) questions as to whether certain antenatal care (ANC) services were performed during their visit. Six items, from both the women's recall and health facility information, were summed to create a composite score for the number of ANC services performed (see Appendix III for further details on the quality index). The composite score also assessed availability of drugs and equipment necessary for ANC services. The same was done for curative care, institutional deliveries, PNC and extended program on immunization (EPI). The overall quality index was a composite of the above-mentioned quality of care measures.

Data analysis

Due to the nature and design of the PBF program evaluation, i.e., quasi-experimental, the DID method was used to estimate PBF's effect on quality of care for specified MCH services. A composite quality of care measure (QoC) was constructed by summing the quality measures for the five MCH services, namely ANC, PNC, EPI, delivery, and curative care (refer to Appendix III). The DID method compares the change in quality of care in the PBF group to the change in outcomes in the control group. The method allowed for control of observed and unobserved time invariant characteristics as well as for time-varying factors that exist in both the PBF and control facilities and time varying observables. Changes in quality of care observed among control facilities was considered to reflect the change that would have happened among RBF facilities had they not implemented PBF. A multivariate regression specification of the DID model was estimated where individual quality of care measures was regressed against a dummy variable indicating whether the facility was receiving under PBF a pre- or post-indicator, and a series of individual, health facility, and household characteristics. Robust standard errors clustered at the district level were calculated to correct for correlation of the error terms. The models were estimated using Stata version 13. The analysis was carried out in two stages.

Stage 1: effects of PBF on quality of care

Health facility data merged with household files informed this analysis. The DID regression model was estimated as following:

$$QoC_{ifd} = \beta_0 + \beta_1(T)_f + \beta_2(PBF)_d + \beta_3(T^*PBF)_{fd} + \varepsilon_{ifd}$$

where *i* is the sample of women who gave birth in the two years prior to the assessment in the facility *d*. PBF_{id} is an indicator showing the treatment status of the facility. T_{id} represents the time-period under consideration; it takes the value 1 if year is 2014 and 0 if 2010. The constant β_0 is baseline estimator of mean quality measure in the control facilities and β_1 measures the baseline difference in mean quality between the control and PBF facilities prior to implementation of PBF; β_2 is the difference between the estimated mean quality measurement pre- and post-PBF among the control facilities. The effect of PBF on quality was estimated by β_3, and ε_{id} is the error term adjusted for clustering at district level.

To investigate heterogeneity by baseline contextual factors, contextual factors were interacted with treatment to identify salient factors that significantly affected the treatment's effect on quality of care measures. These factors were introduced to determine the most influential factors using the following joint regression specification. We estimated the following model:

$$QoC_{ifd} = \beta_0 + \beta_1(T)_f + \beta_2(PBF)_d + \beta_3 T^*PBF_{fd} + \beta_4 X_{ifd} + \beta_5 X_{ifd}{}^*T^*PBF_{fd} + \varepsilon_{fd},$$

where the parameter of interest is β_5, which captures whether the impact of PBF differs by pre-specified baseline characteristics.

Stage 2: contextual factors that mediate the influence of PBF on quality of care measures

Given this evidence, four hypotheses informed development of a list of variables to use for this analysis. We test four different baseline contextual factors. First, we look at whether the PBF effect on quality of care measures is diminished for health facilities located farther from the district city capital (administrative center for the health sector). This could be because facilities incur more costs to achieve minimum quality of care standards relative to those located near the district capital. Second, we look at whether the PBF effect on quality of care measures is stronger for higher levels of baseline health worker

Table 1 Variables used to identify contextual factors

Category	Factors
Features of location/ population, fixed and beyond control of the health system	Geographic remoteness of a health facility. This was covered in two parts, i.e., the distance between the household and the health facility and then the distance between health facility and central district health facility
	Facility catchment population
	Mean population wealth
Features under the control of the health system	Staffing at baseline (health worker designation, i.e., whether the staff member was a nurse aid, primary care nurse (PCN), state certified nurse (SNC), registered general nurse (RGN), or midwife)
Features directly influenced by the program	Health worker satisfaction at baseline

satisfaction, possibly because satisfied health workers are more motivated to provide better quality of care. Third, we look at whether the PBF effect on quality of care measures is stronger for facilities managed by health workers with higher qualifications, possibly because higher qualifications position health workers to adhere to minimum standards of care. Finally, we test whether the PBF effect on quality of care measures is stronger for facilities serving larger catchment areas, possibly because when earning potential is higher, facilities can access more resources to improve the service delivery environment.

To test these hypotheses, variables were classified into three categories, i.e., variables that were: (I) fixed and beyond health facilities' control; (II) under the influence of the health system; and (III) directly influenced by the PBF program (refer to *Table 1* below).

This study did not collect any human studies data and used data obtained from existing databases so that ethical approval was waived.

Results

The original PBF evaluation survey was carried out in 32 districts (16 control and 16 treatment), 145 communities (62 control and 83 PBF), 2,333 households, and 220 health facilities, and with 524 health workers. Datasets were merged to pair communities to health facilities to households with the objective of measuring and investigating the impact of contextual factors. Ensuring only matched districts were kept in the dataset resulted in a final dataset of 56 facilities (20 control and 36 treatment) in 22 districts (11 treatment and 11 control). Of these 20 were control and 36 were PBF facilities.

Summary of the numbers included and those excluded for each data component, i.e., households, communities, health facilities, and health workers, is given in *Table 2*.

Table 2 Summary of Included data components

Data level	Original	Used in analysis
Districts	32	22
Communities	145	55
Households	2,333	1,104
Health facilities	220	56
Health workers	524	103

Table 3 summarizes the differences between PBF and non-PBF facilities at baseline. Overall, facilities under PBF were more likely to be farther from their district's central health facility (P=0.036). Control facilities were on average 2.0 km away from the district capital, while PBF facilities were on average 2.6 km away. The catchment populations of facilities under PBF and control were no different (P=0.506). For health workers, almost a quarter of the health workers assessed were either state certified nurses (SCNs) or registered general nurses (RGNs). Fewer than 1% of facility health workers were only primary school educated; education attainment was similar among health workers from PBF and control health facilities. Years of post-qualification experience and sex distribution were similar for PBF and control facilities. Job satisfaction was higher among health workers in PBF facilities compared to health workers in control facilities (P=0.014).

A total of 464 households were interviewed (see *Table 4* below). The average distance between households and health facilities was similar in the control and PBF communities. Households were on average 11.7 km away

Table 3 Facility characteristics and baseline balance

Characteristics	Control (%)	PBF (%)	P value
Health facility characteristics	N=20	N=36	
Distance between health facility and district's capital			
Central facilities	5.6	0.0	
Less than 20 km	21.4	9.5	
20 to 39 km	42.1	41.4	
40 to 59 km	26.2	21.0	
60 to 85 km	4.8	28.1	0.036
Catchment population			
Less than 5,000	38.5	45.8	
5,000–9,999	46.0	47.2	
10,000+	15.5	6.9	0.516
Health worker characteristics	N=38	N=65	
Health worker designation			
State certified/registered nurses	18.6	11.1	
Primary care nurses	69.5	67.5	
Midwives	4.7	0.0	
Others/lower	7.1	21.4	0.229
Educational attainment			
Primary	0.9	0.8	
Secondary	42.3	54.0	
Higher	56.5	36.5	
Other	0.3	8.7	0.873
Years of post-qualification experience			
Less than a year	0.0	7.9	
1 to 4	28.4	41.3	
5 to 9	54.1	39.7	
10 to 14	4.1	1.6	
15 or more	13.3	9.5	0.102
Sex			
Male	30.2	27.0	
Female	69.8	73.0	0.777
Job satisfaction: compensation			
Very unsatisfied	0.3	0.0	
Unsatisfied	33.4	8.7	
Satisfied	62.1	69.1	
Very satisfied	4.1	22.2	0.014

Compensation and overall job satisfaction used as these measures were best available estimates for overall job satisfaction. Clustered at district level.

Table 4 Effects of PBF on quality of care

Quality of care index	Mean at baseline		Mean at end line		Impact	P value
	PBF	Control	PBF	Control		
ANC	0.66	0.67	0.73	0.68	−0.04	0.846
Institutional delivery	0.71	0.74	0.72	0.67	0.01	0.08*
PNC	0.63	0.69	0.67	0.63	−0.02	0.937
EPI	0.81	0.80	0.83	0.84	0.16	0.364
Curative care	0.75	0.74	0.72	0.69	0.13	0.171
Overall	3.56	3.65	3.67	3.50	0.63	0.552

Sample 1,104 pregnancies. *, P<0.1. Impact measured by linear probability model with difference-in-difference specification, including stratification controls. Errors are clustered at the district level.

from health facilities. Education attainment among women seeking services was not different between control and PBF facilities. Seeking of ANC among women differed between the PBF and control areas.

Effect of PBF on quality of care

Table 4 investigates the effect of PBF on quality of care. After controlling for baseline imbalances, change in quality of care over time differed among the five services reviewed, i.e., ANC, PNC, institutional delivery, curative care, and EPI. PBF was found to have no effect on quality of care for any services, except institutional deliveries. PBF improved quality of delivery by 0.01 percentage points. After running a DID analysis on composite on quality of care, it was found that, overall, PBF had no effect on quality of care for these maternal, neonatal, and child health services.

Because of the loss of facilities during pairing of health facilities to communities, analysis was carried out on facilities not included in the final analysis to check similarities and differences between included and excluded health facilities and to check for any systematic loss of facilities that would likely result in selection bias. Effect of PBF on quality of health services was calculated for excluded health facilities and compared to results from included health facilities. Analysis on unmerged health facilities was also carried out to find out the impact of PBF on quality of care (refer to Appendix IV: Table S3).

Baseline contextual factors

Table 5 presents results from investigations on the role of individual contextual factors on their impact of PBF on quality of care. An increase by a kilometer in the distance between health facilities and communities decreased the impact of PBF on quality of care by about 1.21% (P=0.0020), while distance between health facility and the district capital center increased impact of PBF on quality of care by less than 1% for every kilometer. Catchment area population size and mean population wealth also had no impact. Availability of skilled health workers had no impact on PBF effects on quality of care. However, health workers' job satisfaction significantly increased the impact of PBF on quality of care by 27.7% (P<0.0001).

Discussion

Overall, PBF had no effect on quality of care of the selected MCH services. PBF did have a marginal effect on provision of quality institutional deliveries. Quality of care for the other four services, i.e., ANC, PNC, curative care, and EPI, were not affected by PBF. This is consistent with several studies that demonstrate that the uptake and quality of services (such as EPI, ANC, and PNC) that require repeated visits are mainly influenced by patients' willingness to follow up on all visits (23).

Study findings pointing to PBF's mixed effects on different quality of care outcomes are consistent with various other studies (5,24-26). As a strategic purchasing tool, PBF should have a clear focus informed by a country's context. Thus, policy makers and program managers must have clear understanding of structural prerequisites and related process quality measures that influence achievement of desired quality outcomes (5). In the case of Zimbabwe's PBF program, policy makers and program planners could be more strategic in selecting the structural and outcome

Table 5 Influence of contextual factors on PBF effects on quality of care

Variables	Impact	P value	95% confidence interval
Features of location/population, fixed and beyond control of the health system			
Distance between health facilities and communities	–1.21	0.0020***	–1.97 to –0.45
Distance between health facilities and district capital	0.83	<0.0001***	0.53 to 1.13
Catchment area population	2.2	0.843	–21.3 to 25.8
Mean population wealth	7.7	0.356	–9.4 to 24.8
Features under the control of the health system			
Availability of skilled worker	–8.15	0.214	–17.24 to 0.94
Features directly influenced by the program			
Health workers' job satisfaction	27.66	<0.0001***	20.11 to 35.22

Sample 1,104 pregnancies. ***, P<0.01. Impact of features of location/population, fixed and beyond control of the health system on quality of care were done using linear regression while the rest were measured by linear probability model with difference-in-difference specification, including stratification controls. Errors are clustered at the district level.

indicators incentivized by the PBF program. The quality checklist used at program inception has several structural quality indicators not directly linked with improving EPI or curative care, which might explain the limited effects of the incentives on improving these outcomes.

The mediating effect of baseline contextual factors on PBF and quality of care outcomes is mixed. The two components of geographical remoteness of health facilities had varied influence on the effect of PBF on quality of care. Although distance between health facilities and households decreased the quality of health services by about 1.2 percentage points (95% CI: –1.97, –0.45), distance between health facilities and their district capital centers had no impact. PBF's compensation for geographic remoteness, through an added bonus to health facilities located farthest from district capitals, could have played a positive role in influencing health providers to achieve better quality of care. Earlier qualitative studies in Zimbabwe found that the size of the PBF incentive plays a positive role in motivating health providers (27).

Household wealth did not have any impact on PBF's effect on quality. This contradicts existing evidence that wealth plays a vital role in household health seeking behavior. In 2014 Matovu *et al.* found that in Uganda, both indirect and direct costs of seeking health were detrimental to household access to health care (28). Lack of influence of household wealth on effect of PBF on quality of care may point to more deterring household factors, one of them being distance to a health facility. Evidence shows that distance of households to the nearest health center is highly detrimental to access and frequency of clinic attendance to health services, even with the removal of user fees (29-31)

Availability of skilled health staff does not necessarily result in improved quality of health services. This is consistent with findings from Matsuoka *et al.*, 2014, who found that on-the-job training and refresher courses were more useful for improving quality of care than just the implementation of PBF and availability of staff at the health facilities (32).

Levels of health worker satisfaction with their compensation was found to cause the largest change in PBF's effect on quality. Health worker satisfaction with compensation improved PBF's effect on quality of health services by 27.7 percentage points (95% CI: 20.1, 35.2). The role of such a contextual factor—one within policy-maker control—underscores the importance of understanding the role played by those contextual factors influenced by the health system and those influenced by programs.

This study provides evidence that availability of health workers who are satisfied, and hence willing to provide their best skills to improve quality of health services, is central to successful PBF implementation.

Limitations

The results from unmerged health facilities on effect of PBF on quality of care differ because of baseline imbalances between the two sets of health facilities, i.e., unmerged and merged health facilities. Hence results from this subset of merged health facilities cannot be used to generalize results

for all facilities under PBF.

Conclusions

Evaluations of complex health system reform interventions such as PBF must go beyond exploring effects on priority health outcomes. Evidence on the role of contextual factors is equally important in understanding complex health system interventions. This study provides evidence on the extent to which contextual factors mediate PBF's effect on quality of care. Contextual factors relevant to policy makers and the health systems they are seeking to strengthen can be considered during the design of future studies. On the other hand, contextual factors outside the control of policy makers and the health system—such as mean population wealth—must be further studied.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study did not collect any human studies data and used data obtained from existing databases so that ethical approval was waived.

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Appendix I Study intervention

Summary description of intervention

The PBF program offers a quarterly financial reward to health facilities based on their verified delivery of a well-prioritized, high-impact package of 16 MCH services at rural health center (RHC) level, and five referral services at secondary hospital level (Tables S1 and S2).

Health facility teams can use 25% of the PBF payment for staff incentives and 75% to improve delivery and quality of health services. Incentives are divided among individuals based on a formula that gives more weight to health workers working in higher positions, having longer tenure, and assuming more direct responsibility for the incentivized services.

An internal verification process is undertaken by Cordaid, an international NGO that audits self-reported quantity data by health providers. Quarterly quality audits by the District Health Executive (DHE) and Provincial Health Executives (PHEs) verify the quality of services provided based on a standard protocol. Community-based organizations (CBOs) undertake client tracer and satisfaction surveys using a predefined instrument. Client feedback and assessment of services received constitutes 20% of the overall quality score received by a health provider in a given quarter. An external verification undertaken by the University of Zimbabwe Department of Community Medicine independently audits the reported data. At the district level, hospitals receive performance-based contracts to improve the quality of emergency

Table S1 PBF services and subsidies in rural health centers (primary level)

Indicator number	Indicator	Current price (after Sept. 2013), $	Price before Sept. 2013, $
1	OPD new consultations[1]	0.10/0.05	0.16
2	1st ANC Visit during first 16 weeks[2]	3.00	3.00
3	ANC 4+ visits completed	3.00	3.00
4	HIV VCT in ANC	1.00	2.00
5	ARVs to HIV+ pregn. Women (PMTCT)	2.50	2.00
6	Tetanus TT2+	0.45	0.45
7	Syphilis RPR test	0.45	0.45
8	IPT (×2 doses)	0.45	0.45
9	Normal deliveries	12.50	12.50
10	High risk perinatal referrals	3.00	3.00
11	PN visits 2 or more	4.50	3.00
12.a	Family planning, short term methods	1.00	2.50
12.b	Family planning, long term methods	5.00	50.00
13	Pri. course completed, immunization	3.50	3.50
14	Vit. A supplementation	0.18	0.18
15	Growth monitoring, children <5 yrs	0.18	0.18
16	Acute Malnutrition cured & discharged children <5 yrs[3]	Moved to sec level	3.00

[1], $0.05 for peri urban/high volume; $0.10 for other facilities. [2], indicator added after the PBF technical review. [3], indicator added after the PBF technical review.

TableS2 PBF services and subsidies in district hospitals

Indicator number	Indicator	Current price (after Sept, 2013), $	Price before Sept, 2013, $
1	Normal deliveries[1]	12.50/25	25
2	Deliveries with complications	50	80
3	Caesarean sections	140	140
4	Family planning tubal ligations	30	30
5	High-risk per-natal referrals	3	3
6	Acute malnutrition cured & discharged children <5 yrs[2]	3	

[1], normal deliveries are not supposed to be done at a hospital except for refereed complicated deliveries. For hybrid hospitals, normal deliveries are paid $12.50 for walk in and $25.00 for referred cases. [2], indicator added after the PBF technical review.

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obstetric care and district health management teams are contracted to strengthen quality of supervision. Remote facilities receive higher payments for the delivery of the package of services.

Main project components include: (I) performance-based contracts with health facilities in urban and rural areas; (II) management and capacity building in PBF; (III) monitoring and documentation; and (IV) vouchers for maternal and neonatal services in low-income urban communities.

The formula below shows how the PBF bonus is calculated for the facilities:

$$P = (1+Q)\{\sum_{i=1}^{n} a_i b_i + R\}$$

where P = PBF payment; Q = quality score; a_i = unit price for indicator I; b_i = quantity achieved for indicator i; R = remoteness bonus. Until June 2013, Q was simply the raw score on the quality index. From September 2013, Q is 0–25%, depending on the facility's score on the quality index.

In its regulatory role, the DHE monitors the performance of the health facilities (HFs), which are responsible for direct health care service delivery to communities. The DHE provides feedback and supportive supervision to HFs to enhance their skills and improve their performance. The Health Center Committee: (I) assists the HFs to manage and mobilize locally available resources from communities within an HF's catchment area; and (II) helps ensure the community has a platform to voice their input and perspectives on the project. CBOs are tasked with conducting quality and patient satisfaction surveys.

Appendix II Methodology for matching health facilities and communities

This brief paper outlines the methodology of the geographic match made between communities and health facilities (HFs) in the Zimbabwe PBF program. It explains the algorithm and its underlying assumptions and concludes with a brief explanation of the resulting dataset.

The data

The World Bank conducted a Results-Based Financing (i.e., PBF) program in Zimbabwe during 2010/2011 and 2014 (baseline and end line years). These surveys went out to treatment health facilities and nearby households, selected control districts and their respective health facilities, and households in catchment areas. No household data was collected at baseline, so the Demographic Health Survey for Zimbabwe was used in lieu of a formal, separate sample.

Matching methodology

During data cleaning, all communities without geographical data were excluded from the analysis. The algorithm then calculated the distance between each community and each health facility. Every community and health facility pair within 10 kilometers (km) of each other received an indicator and were removed to a separate dataset. The procedure was then repeated with a radius of 20 km, this time deleting all instances of communities and health facilities that had at least one match in the 10 km search before determining which communities/health facilities were within 20 km of each other. Matches at the 20 km radial level were then appended to the 10 km dataset. These two steps were repeated once more for a 30 km radius, again eliminating all community/health facility pairs that matched in either the 10/20 km search and appending to the 10/20 km dataset, and stopped after this point.

The resulting matched dataset attempted to pair communities to their nearest health facilities, on the assumption that they will most likely frequent the health facilities closest to them. This procedure did not pair households with health facilities across district lines. The particular circumstances in Zimbabwe suggest that households will not travel to health facilities in another district, so matching them would be improper.

The reasoning behind the radial search procedure tried to balance three principles simultaneously. They were, in order of priority:

(I) Find communities to pair with as many health facilities in our dataset as possible;
(II) Match communities to their closest health facilities (avoid Type I error); and
(III) Since the sample does not include every single health facility in the country, ensure we do not match communities to health facilities when they would actually go to a different, non-sampled health facility that is closer (avoid Type II error).

Type I errors would occur if we say communities do not match to a health facility when they, in fact, do. This would likely happen if we do not match a community to a "nearby" health facility, based on some measure of geographic distance. No communities more than 30 km away from a health facility will ever be matched, and the radial search brings some extra rigor to the nearest health facility principle. Type II errors occur if we say a community matches with a health facility when it in fact does not. We are fairly confident that communities within 10 km of a health facility would use that health facility, so the first radial search should be fairly error-free. The second 20 km search only searches for health facilities that do not have any communities yet paired with them. This searches over a list of communities that have not been paired up yet either. A similar procedure occurs with the 30 km search. The algorithm stops after 30 km because we assume that no community will travel more than 30 km to a health facility, at least for the services this survey addresses.

Results

These cleaning and matching procedures produced a dataset with 84 health facilities paired with 91 community centers. There were 1,740 total observations, where an observation represented most recent births to women in households within 10/20/30 km of a paired health facility.

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Appendix III Questionnaire on patient satisfaction

2	Treatment and counseling				Record response
(2.01)	Do you have an antenatal-care card/ book, or an immunisation card with you today? If yes: ask to see the card/book.	Yes	1		
		No, card kept with facility	2	► (2.06)	
		No, card/book used	3	► (2.06)	
(2.02)	Check antenatal-care card/book, or immunisation card. Indicate whether there is any note or record of the client having received tetanus toxoid.	Yes, 1 time	1		
		Yes, 2 or more times	2		
		No	3		
(2.03)	How many weeks pregnant is the client, according to the ANC card? In weeks	Information not available	99		
(2.04)	Does the card indicate the client has received IPT? (if non malarious area, choose "not applicable")	Yes, 1 dose	1		
		Yes, 2 doses	2		
		No	3		
		Not applicable	98		
(2.05)	Does the card/book mention the client's blood group?	YES	01		
		NO	02		
(2.06)	How long have you been pregnant? (record months or weeks) Record 99, if not known	a. Weeks			
		b. Months			
(2.07)	Is this your first pregnancy?	Yes	1		
		No	2		
(2.08)	Is this your first antenatal visit at this facility for this pregnancy?	Yes	1	► (2.10)	
		No	2		
(2.09)	Including this visit, how many antenatal care visits have you had for this pregnancy to this health facility?				
(2.10)	How many antenatal care visits have you had for this pregnancy to other health facilities?				
(2.11)	During this visit, were you weighed?	Yes	01		
		No	02		
(2.12)	During this visit or earlier visit, was your height measured?	Yes	01		
		No	02		
(2.13)	During this visit, did someone measure your blood pressure?	Yes	01		
		No	02		
(2.14)	During this visit, did you give a urine sample?	Yes	01		
		No	02		
(2.15)	During this visit, did you give a blood sample?	Yes	01		
		No	02		
(2.16)	During this visit, did you schedule your delivery in the facility?	Yes	01		
		No	02		
(2.17)	During this visit, was your abdomen measured with a tape?	Yes	01		
		No	02		
(2.18)	During this visit, did the provider palpate your abdomen?	Yes	01		
		No	02		
(2.19)	During this visit or earlier visit, did the health worker estimate your delivery or due date?	Yes	01		
		No	02		
(2.20)	During this visit, did a health worker ask for your blood type/group?	Yes	01		
		No	02		
(2.21)	During this visit, did a health worker give you advice on your diet (this is, what to eat and drink) during pregnancy?	Yes	01		
		No	02	► (2.23)	
(2.22)	What did the health worker advise you to eat during pregnancy?	a. Green leafy vegetables			
		b. Milk			
	Do not cite answers, but for each option record "1" if mentioned, "2" if not mentioned. you may probe without using specific answers (e.g., "anything else?")	c. Meat and poultry			
		d. Fruits and nuts			
		e. Sadza/rice/potatoes/cassava			
		f. Other (specify: _____)			
(2.23)	During this visit, or previous visits, did the provider give you iron pills, folic acid or iron with folic acid, or give you a prescription for them?	Yes, this visit	1		
		Yes, previous visit	2	► (2.25)	
		No	3	► (2.28)	
		Don't know	99	► (2.28)	
(2.24)	Ask to see the client's iron/folic acid/ iron with folic acid pills.	Saw pills	1		
		Saw prescription	2		
		No pills or prescription	3		
(2.25)	During this visit or previous visits, has a provider explained to you how to take the iron pills?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
(2.26)	During this or previous visits, has a provider discussed with you the side effects of the iron pill?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
(2.27)	Please tell me any side effects of the iron pill that you know of. Record "1" if mentioned, "2" if not mentioned. for each option. do not read the list.	a. Nausea			
		b. Black stools			
		c. Constipation			
		d. Other			
		Specify			
(2.28)	During this or previous visits, has a provider given or prescribed any anti-malarial pills for you? Show the client capsules of Fansidar.	Yes, this visit	1		
		Yes, previous visit	2		
		No	3	► (2.30)	
(2.29)	Did a provider explain to you how to take the anti-malarial pills?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
(2.30)	Do you own an ITN, that is a net that has been treated with an insecticide to protect you from mosquito bites?	Yes	1		
		No	2		
(2.31)	During this visit or a previous visit, did a provider offer you an ITN free of charge or offer to sell you one? If the client will pick up or buy the ITN within the facility, that counts as provider offering the ITN.	Yes, offered free now	1		
		Yes, offered free in previous visit	2		
		Yes, offered for sale now	3		
		Yes, offered for sale in previous visit	4		
		No, not offered	5		
(2.32)	During this visit or a previous visit, did a provider discuss the importance of sleeping under an insecticide treated net?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
(2.33)	Last night, did you sleep under an insecticide treated net?	Yes	1		
		No	2		
(2.34)	During this visit or previous visits, has a provider asked you whether you had ever received a tetanus toxoid (TT) injection?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
(2.35)	Have you ever received a tetanus toxoid (TT) injection, including one you may have received today? If yes: including any TT injection you received today, how many times in total during your lifetime have received a tetanus toxoid injection? (injection may have been received either at this facility or elsewhere.)	Yes	1		
		Never	2	► (2.37)	
(2.36)	Number of tetanus injections received				
(2.37)	During this visit or previous visits, has a provider discussed things you should have in preparation for your delivery? This may include planning in case of emergency, things you should bring to a facility, or things you should prepare at home for home delivery.	Yes	1		
		No	2		
(2.38)	Please tell me any things you know of that you should have in preparation for your delivery. record "1" if mentioned, "2" if not mentioned. Do not read the list.	a. Emergency transport			
		b. Money			
		c. Methylated spirit			
		d. Sterile blade/scissors to cut cord			
		e. Layette			
		f. Sanitary pads/cotton wool			
		g. Other			
		Specify			
(2.39)	Do you have money set aside for the delivery? IF YES, PROBE	Yes, enough	1		
		Yes, but not enough	2		
		Yes, not sure	3		
		No	4	► (2.42)	
(2.40)	How much do you currently have set aside for delivery?	a. US Dollar			
		b. ZA Rand			
		c. Others (Specify)			
(2.41)	How much do you need to have set aside for delivery?	a. US Dollar			
		b. ZA Rand			
		c. Others (specify)			
(2.42)	During this visit or previous visits, has a provider talked with you about any signs of complications (danger signs) that should warn you of problems with the pregnancy?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3	► (2.45)	
(2.43)	Please tell me any signs of complications (danger signs) during pregnancy that you know of.	a. Any vaginal bleeding			
		b. Fever			
	Do not cite answers, but for each option record "1" if mentioned, "2" if not mentioned. you may probe without using specific answers (e.g., "anything else?")	c. Swollen face, hands or legs			
		d. Tiredness or breathlessness			
		e. Severe headache			
		f. Blurred vision			
		g. Convulsions/fits			
		h. Lightheadedness/dizziness/blackout			
		i. Severe pain in lower belly			
		j. Baby stops moving or reduced fetal movement			
		k. Bag of water breaks or leaks			
		l. Difficulty breathing			
		m. Other (specify: _____)			
(2.44)	What did the provider advise you to do if you experienced any of the warning signs? Record "1" if mentioned, "2" if not mentioned for all responses the client mentions. probe without using specific answers.	a. Seek care at facility			
		b. Decrease activity			
		c. Change diet			
		d. Other (specify: _____)			
(2.45)	Do you know any danger signs during/ after delivery?	Yes	1		
		No	2	► (2.47)	
(2.46)	What danger signs do you know? Record "1" if mentioned, "2" if not mentioned for all responses the client mentions. probe without using specific answers.	a. Bleeding			
		b. Fever			
		c. Genital injuries			
		d. Other			
(2.47)	During this visit or previous visits, has a provider spoken to you about breastfeeding?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3	► (2.51)	
(2.48)	During the discussion, did the provider discuss exclusive breastfeeding (giving the baby nothing apart from breast milk)?	Yes	1		
		No	2	► (2.51)	
(2.49)	When did the provider explain you should start exclusive breastfeeding?	FIRST HOUR	01		
		FIRST DAY	02		
		FIRST WEEK	03		
		FIRST MONTH	04		
(2.50)	For how many months did the provider recommend that you exclusively breastfeed, that is, that you do not give your baby liquid or food in addition to your breast milk?				
(2.51)	During this visit or previous visits, did the provider talk to you about where you plan to deliver your baby?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
(2.52)	Have you decided where you will go for the delivery of your baby? If yes: probe for whether the plan is to deliver in a facility or at home	At this health facility	1		
		At other health facility	2		
		In a private home	3		
		Other	96		
		Specify			
(2.53)	During this or previous visits, did a provider talk with you about using family planning after the birth of your baby?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3	► (2.55)	
		Don't know	99		
(2.54)	Which methods did the provider discuss?	a. Female sterilization			
		b. Male sterilization			
	Record "1" if mentioned, "2" if not mentioned for all responses the client mentions. Probe without using specific answers.	c. Contraceptive pill			
		d. Intrauterine device (IUD)			
		e. Injectable contraceptives			
		f. Implants			
		g. Male condoms			
		h. Female condoms			
		i. Diaphragm			
		j. Foam/jelly			
		k. Lactational amenorrhea			
		l. Rhythm method			
		m. Withdrawal			
(2.55)	During this or previous visits, did a provider talk with you about HIV testing?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
		Don't know	99		
(2.56)	During this or previous visits, did a provider talk with you about HIV counseling?	Yes, this visit	1		
		Yes, previous visit	2		
		No	3		
		Don't know	99		

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Appendix IV Results

Table S3 Impact of PBF on quality of care, all health facilities

Quality of care index	Mean at baseline		Mean at end line		Impact (%)	P value
	PBF	Control	PBF	Control		
ANC	0.68	0.67	0.74	0.68	5.6	0.105
Institutional delivery	0.74	0.75	0.74	0.69	5.6	0.185
PNC	0.67	0.66	0.61	0.68	6.3	0.213
EPI	0.84	0.83	0.82	0.84	1.6	0.617
Curative care	0.77	0.75	0.73	0.71	0.3	0.936
Overall	3.56	3.65	3.67	3.5	18.7	0.334

Clustered at district level.

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