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Introduction Of Performance-Based Financing In Burundi Was Associated With Improvements In Care And Quality

ABSTRACT Several governments in low- and middle-income countries have adopted performance-based financing to increase health care use and improve the quality of health services. We evaluated the effects of performance-based financing in the central African nation of Burundi by exploiting the staggered rollout of this financing across provinces during 2006–10. We found that performance-based financing increased the share of women delivering their babies in an institution by 22 percentage points, which reflects a relative increase of 36 percent, and the share of women using modern family planning services by 5 percentage points, a relative change of 55 percent. The overall quality score for health care facilities increased by 45 percent during the study period, but performance-based financing was found to have no effect on the quality of care as reported by patients. We did not find strong evidence of differential effects of performance-based financing across socioeconomic groups. The performance-based financing effects on the probability of using care when ill were found to be even smaller for the poor. Our findings suggest that a supply-side intervention such as performance-based financing without accompanying access incentives for poor people is unlikely to improve equity. More research into the cost-effectiveness of performance-based financing and how best to target vulnerable populations is warranted.

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Several governments in low- and middle-income countries have adopted performance-based financing in the health care sector—payment methods that reward performance. In Africa alone more than thirty-five countries are in the process of introducing performance-based financing.^{1,2} Performance-based financing is a strategy to improve the performance of health care providers through the use of explicit financial incentives for reaching targets on predefined performance measures related to the quantity and quality of health care services.³ Traditionally, in low-income countries, health system fi-

ancing is based on prospective budget flows derived from, for example, bed counts or estimates of needed pharmaceuticals. Under performance-based financing, health care facilities are reimbursed retrospectively after verification of the quantity and quality of provided services.

While there is considerable enthusiasm among practitioners and implementers about the promise of performance-based financing,^{4–6} robust evidence on its effects in low- and middle-income countries is still limited.^{7–9} A systematic review by Sophie Witter and colleagues¹⁰ identified one study¹¹ on the effects of bonuses for doctors meeting higher quality standards in the Philippines as

the only study with low risk of bias. This study of the Philippines system found that performance-based financing improved children's general health and reduced wasting, the process of muscle and fat tissue "wasting" away, but had no effect on patient volumes in the studied hospitals or quality scores for hospital care, as assessed through a quality measurement system developed for the study. Similar effects were found for another intervention group for which health insurance reimbursements to hospitals were increased, which suggests that in the Philippines the effects were also driven by increased resources.¹¹

For Rwanda, the first African country to introduce nationwide performance-based financing, results from a difference-in-differences analysis^{10,12} indicated that such financing increased the quality and use of maternal and child health services and child nutritional outcomes. An experiment conducted in the Democratic Republic of Congo showed that performance-based financing led to lower direct payments by patients to health facilities, comparable or better services, and higher quality of care.¹³

Winnie Yip and colleagues¹⁴ recently evaluated a capitation with pay-for-performance intervention in the Ningxia Province of China. This program focused on primary care providers' antibiotic prescribing practices, health spending, outpatient visit volume, and patient satisfaction. The intervention led to a reduction of approximately 15 percent in antibiotic prescriptions and a small reduction in total spending per visit to primary health care providers. No effect on other outcomes was found.

This article adds to the limited scientific knowledge on the effects of performance-based financing in low- and middle-income countries. We exploit the staggered rollout of performance-based financing across provinces in the central African nation of Burundi during 2006–10 and use a difference-in-differences approach to identify the effects of performance-based financing on the use and quality of health care. Our results indicate that the introduction of performance-based financing led to some improvements in maternal care use and in health care facilities' quality scores.

Performance-Based Financing In Burundi

In December 2006 performance-based financing was implemented in Burundi by the Ministry of Health, with help from nongovernmental organizations (NGOs), in three provinces: Bubanza, Cankuzo, and Gitega I. In October 2008 the financing system was implemented in six more

provinces: Karuzi, Makamba, Bururi, Rutana, Ruyigi, and Ngozi. In April 2010 the financing system was implemented in the remaining provinces: Bujumbura-mairie, Bujumbura-rural, Cibitoke, Gitega II, Kayanza, Kirundo, Muramvya, Muyinga, and Mwaro.¹⁵ (Gitega province was split into two similar sized areas: the area where performance-based financing was implemented first [Gitega I] and the remaining area [Gitega II].)

In May 2006, seven months before the introduction of performance-based financing in Burundi, user fees for deliveries, cesarean sections, and care for children under age five were removed at public health care facilities throughout the country.¹⁶ To replace the lost income from eliminated user fees, facilities received payments from the government for the services provided for free. Ensuring timely payment to the facilities proved problematic.^{16,17} In April 2010 the Ministry of Health incorporated payment for maternal and child health services into the performance-based financing scheme.

As of 2014, performance-based financing has been implemented in almost 700 Burundi health care facilities¹ and accounts for around 40 percent of the total average health facility budget. Fifty-two percent of the total funding for performance-based financing is provided by the Burundese government, 28 percent by the World Bank, and the remaining 20 percent from various other donors.^{17,18} Facilities receive payments based on the quantity and quality of health services provided.¹⁹

Quantity is measured through twenty-three output indicators.²⁰ (See online Appendix 1.)²¹ For this study, data were collected for six of these output indicators. Health care facilities report monthly to the Ministry of Health about quantities of health services delivered for each indicator. Reported quantities are verified and validated by a provincial committee through unannounced observation visits to facilities.

In addition to the quantity-based payments, facilities can receive a quality bonus of up to 25 percent. Quality is assessed quarterly by local regulatory authorities on a randomly chosen day using a checklist^{17,22} containing 220 items grouped into the following topics: general infrastructure and communication, business plan, income and costs, hygiene and sterilization, outpatient consultations, family planning, laboratory services, inpatient care, management of essential drugs, availability of essential drugs, maternal care, surgery, tuberculosis screening, vaccination, and antenatal care. The total payment to a facility is calculated as a weighted sum of the number of provided services in the previous three months times their unit payment mul-

tiplied by the quality bonus, which ranges between 1 and 1.25 depending on the score obtained from evaluation of facilities based on results of the checklist assessment.

Study Data And Methods

DATA SOURCES Repeated cross-sectional household surveys were conducted in 2006, 2008, and 2010 in selected provinces. In 2006, data were only collected in four provinces (two intervention and two control); from 2008 onward, the survey was extended to eleven provinces to include all provinces in which performance-based financing was introduced at that time (see Appendix 2 for detailed sample sizes).²¹ Exhibit 1 provides an overview of the timing of performance-based financing introduction relative to the survey dates across provinces. Three phases can be distinguished: phase 0 (baseline), phase I (first stage of rollout), and phase II (second stage of rollout). Note that the data collection in 2008 took place before the second stage of rollout, while the data collection in 2010 took place six months after rollout. Before the baseline, the Ministry of Health selected comparable control provinces in terms of income and presence of for-profit health care facilities. The facilities in the control provinces did not receive additional cash support.

SAMPLE AND OUTCOME MEASURES In each round of data collection, households were randomly selected through a clustered sample design (see Exhibit 1 for sample sizes). From the household surveys, five different samples were distinguished: households, women who delivered in the preceding year, infants, women ages 15–49, and illness episodes (see Appendix 2).²¹ The respondents in the latter sample were household members who reported at least one illness episode in the past thirty days and were, therefore, also indicated as “patients.” In addition, a random sample of seventy-five health care facilities across the study provinces was surveyed and revisited in subsequent waves (see Appendix 2).²¹

The household survey collected detailed information on health care use and self-reported satisfaction with health care. Eight main outcomes were identified directly relating to the services incentivized through performance-based financing. The incentivized services that were studied using these main outcomes included antenatal care received, pregnant woman fully immunized, institutional delivery by qualified staff, child younger than one year completely immunized (at least one immunization and *Bacillus Calmette-Guérin* [BCG] immunization), use of modern family planning, and use of at least

one bed net (see Appendix 1).²¹ Because of time and financial constraints, it was not possible to collect information related to the other incentivized services listed in Appendix 1.²¹ The eighth incentivized outcome is quality of care at facilities. Quality scores were obtained through external audits by qualified health care workers who received specific training and were not residing in the province(s) of study. A detailed checklist was used containing fifty-seven items grouped into the topics of infrastructure and communication, outpatient consultations, maternal care, family planning, vaccinations, laboratory services, drug availability, and medical consumables availability¹³ (see Appendix 3).²¹ Scores are summed to a total result that reflects overall process quality of services delivered in the facility.

It should be emphasized that this score is collected by external health care workers who do not work in the facility and is not equal to the score calculated by the local regulatory office and used for performance-based financing payments. The score collected by external health care workers is a condensed version of the one collected by the local regulatory office because of time and budget constraints. The items in the quality score for the study were defined before the program started and capture the essentials of the longer quality checklist used for the calculation of the bonus.

While we provide information on eight sub-categories of this quality score for additional

EXHIBIT 1

Performance-Based Financing (PBF) Status At Time Of Survey Across Provinces In Burundi, Selected Years 2006-10

Province	Phase	2006		2008		2010	
		PBF	N	PBF	N	PBF	N
Bubanza	I	0	125	1	125	1	125
Cankuzo	I	0	100	1	100	1	100
Karuzi	II	0	150	0	150	1	150
Makamba	II	0	125	0	125	1	125
Gitega I	I	0	— ^a	1	75	1	100
Bururi I	II	0	— ^a	0	100	1	100
Bururi II	II	0	— ^a	0	50	1	50
Gitega II	II	0	— ^a	0	225	1	200
Muramvya	II	0	— ^a	0	150	1	150
Rutana	II	0	— ^a	0	125	1	125
Ruyigi	II	0	— ^a	0	125	1	125

SOURCE Burundi Ministry of Public Health, 2011. **NOTES** Sample sizes (N) shown are the number of households interviewed. Gitega province was split into two similar-size areas, the area where performance-based financing was implemented first (Gitega I) and the remaining area (Gitega II). For data collection, Bururi was split into two areas (Bururi I and Bururi II). Implementation of performance-based financing took place at the same moment in time for both areas. An entry of 0 in the “PBF” columns indicates that PBF was not in place; an entry of 1 indicates that PBF was in place. ^aNo data collected.

insight, they are not part of our set of main outcomes. Additional outcomes were used that relate only indirectly to the general performance-based financing aim of increasing accessibility and quality of care: health care use in case of illness, self-reported patient satisfaction, and childbirth in the past twelve months. The childbirth measure is expected to decrease via the effect of performance-based financing on modern family planning. Health care use in case of illness is expected to increase because of the performance-based financing incentives to raise outpatient and inpatient consultation rates. Reported patient satisfaction is also expected to increase in response to the quality incentives connected to performance-based financing. All relevant indirect outcomes that were collected are included in the study. Appendix 4²¹ describes all main and additional outcome measures and their sample means by survey year for phase I and phase II provinces.

ANALYSIS AND EXPLANATORY VARIABLES We identified the effects of performance-based financing by comparing how changes in outcomes of interest (use and quality) correspond to the staggered rollout of performance-based financing in Burundi. We identified the phase I performance-based financing effect by comparing the change in outcomes in the phase I provinces between 2006 and 2008, before versus after the introduction of performance-based financing, relative to the change in the control provinces (those that experienced performance-based financing rollout in phase II). Thereafter, the phase II performance-based financing effect was obtained by comparing the change in outcomes between 2008 and 2010 in phase II provinces with that in the phase I provinces over the same period. Detailed information on sample sizes for phases I and II is provided in Appendix 2.²¹

We identified the effect of performance-based financing in phase I by restricting the sample to data from 2006 and 2008. The provinces Karuzi and Makamba acted as controls for Bubanza and Cankuzo. Thereafter, the effect of performance-based financing in phase II was identified by only using data from after 2006 and by using Bubanza, Cankuzo, and Gitega I as controls for the other provinces.

Finally, we estimated the average effect of performance-based financing on the pooled sample using both the phase I and phase II regions and the full period of data. This gave us the average performance-based financing effect across all phases of implementation. We verified the robustness of the findings by estimating the effects for phases I and II using interaction effects on the full sample. We also allowed for a differential

performance-based financing effect on poor (bottom tertile) and nonpoor households (top two tertiles) by including an interaction term between the performance-based financing indicator and an indicator for the lower-wealth tertile. Household wealth is proxied by total monthly household consumption expenditures, based on a list of eighteen items; weekly and yearly expenditure reports were converted to monthly values.

Because performance-based financing introduction was not randomized, we controlled for other factors that may have influenced the use and quality of health care and may have correlated with the introduction of performance-based financing. All models include year indicators to capture the time trend in outcomes common to treated and control provinces; a full set of province effects to capture time-invariant differences; and a set of time-varying household-level characteristics: household size, income tertile of the household, age and sex of household members, number of illness episodes in the household in the past thirty days, indicators for all girls and boys in school, durable housing material, access to clean water, ownership of fertile land, health insurance, female income earner, married, polygamous, and farmer. Given the availability of panel data for facilities, we used facility fixed effects rather than province fixed effects to correct for differences across facilities.

The identifying assumption of such a difference-in-differences approach is that, conditional upon observable characteristics, in the absence of performance-based financing there would have been no differential changes in the outcomes across these provinces (the parallel trend assumption). We discuss the plausibility of this assumption in the results section. See Appendix 5²¹ for the formal description of the models.

Least squares regression was used for all outcomes, and robustness of results was confirmed using fixed-effect logit models for all binary outcomes. Standard errors were adjusted for clustering at the province level to allow for the possibility of serially correlated province-level shocks.^{23,24} We accounted for the small number of clusters²⁵ and for the possible type I error arising from multiple hypothesis testing.²⁶⁻²⁸ (See Appendix 5 for details.)²¹ The software STATA 13 was used to perform all statistical analyses.

LIMITATIONS There were some limitations to our study. First, as performance-based financing is rolled out at the provincial level in a non-randomized way, it is possible for unobservable characteristics to violate the common trend assumption necessary to claim causality.

Second, because performance-based financ-

ing became a nationwide program in 2010, we have no “pure” control provinces left for the phase II period. To the extent that performance-based financing not only causes a shift in levels of health care use and quality but also causes an upward change in their trends, this could bias our results from the second implementation period downward. The inevitable assumption that phase I districts represent a reliable control for phase II districts is a limitation of the analysis.

Third, we could not distinguish between the *incentive* and *resource* effects of the performance-based financing scheme, because control provinces—unlike intervention provinces—were not given additional resources.¹² However, we do know that the average revenues for health facilities per person per year increased from US\$0.53 to US\$2.49 between 2006 and 2010 in Burundi—an almost fivefold increase. This increase is larger than was reported for Rwanda, where the revenue increase for health facilities was about threefold.¹²

Fourth, our study could examine only a subset of six out of twenty-three performance-based financing output indicators. Fifth, quality could be measured only by process indicators such as the availability of basic medical equipment, infrastructure, correct and up-to-date registries, prescription behavior, and routine.

Study Results

DESCRIPTIVE STATISTICS For most outcomes, phase I and phase II provinces were similar at baseline (see Appendix 4).²¹ The one exception is that institutional deliveries were less common in the phase I provinces (48 percent in phase I versus 73 percent in phase II). Further evidence supporting comparability of phase I, phase II, and provinces not surveyed is provided in Appendix 6,²¹ which does not reveal any systematic differences in terms of child mortality, poverty, education, and health care infrastructure (obtained from other data sources). Between 2006 and 2008, health care use and quality seem to have improved for phase I provinces, while some deterioration was observed in the other provinces. This deterioration could be related to nationwide clashes between government forces and national liberation forces. The positive trend in the phase I provinces might be an indication of the effect of performance-based financing being stronger than the negative effect nationwide of political instability. The government and the liberation forces signed a ceasefire in May 2008.²⁹

It was not possible to formally test the parallel trends assumption that in the absence of performance-based financing there would have been

no differential changes in the trends of the outcomes of these provinces. However, we further assessed the credibility of the parallel trends assumption by comparing pre-intervention trends in maternal and child health care across phase I and phase II provinces using data from the Multiple Indicator Cluster Surveys (MICS) collected in Burundi in 2000 and 2005, which provide information on births from 1996 to 2004, the period prior to performance-based financing introduction. Appendix 7²¹ confirms that pre-intervention trends in the relevant indicators available in the MICS (child’s vaccination card, one BCG vaccination at or close to birth, three or more doses of polio vaccination, three doses of diphtheria-tetanus-pertussis [DTP] vaccination, and at least one dose of measles vaccination) were very similar across the two groups of provinces.

EFFECTS ON USE AND QUALITY OF HEALTH CARE

Exhibit 2 shows the estimated effects of performance-based financing on both incentivized and indirect outcomes. Performance-based financing in phase I significantly increased the proportion of women delivering their babies in an institution by 38 percentage points, which reflects a relative increase of 79 percent. (See Appendix 4 for baseline means.)²¹ The share of pregnant women reporting more than one antenatal care visit increased significantly by 10 percentage points, a relative increase of 11 percent. The proportion of households reporting the use of at least one bed net increased by 14 percentage points, a relative increase of 26 percent. The average quality score constructed from the external audits increased by 23 points, compared to the baseline average of 35 under performance-based financing. Subcomponent quality scores are presented in Appendix 9.²¹ No effect was found of performance-based financing in the phase I provinces on vaccinations and the use of modern family planning.

The lower half of Exhibit 2 shows the estimated effects of performance-based financing on indirect outcomes. Though no significant effect was found on the use of family planning, performance-based financing was found to significantly decrease the proportion of households in which a child was born in the past twelve months by 5 percentage points, a relative decrease of 19 percent. We found no evidence of a performance-based financing effect on the number of times that health care was used in the case of an illness episode or on quality as reported by patients. The share of patients who reported the quality of care and the drug availability to be sufficient, the personnel to be respectful, or the waiting time to be reasonable did not change significantly. There was also no change in the

EXHIBIT 2

Effects Of Performance-Based Financing On Incentivized And Indirect Outcomes In Burundi, Selected Years 2006–10

Outcome	Phase I			Phase II			Pooled		
	Percentage-point change	p value	N	Percentage-point change	p value	N	Percentage-point change	p value	N
INCENTIVIZED OUTCOMES									
Women who delivered in preceding year ($p = 0.19$) ^a									
Institutional delivery	38	0.000	274	14	0.034	715	22	0.000	845
More than one antenatal care visit	10	0.000	274	1	0.764	715	2	0.316	845
More than one tetanus vaccination	6	0.786	274	13	0.294	715	11	0.314	845
Infants ($p = 0.049$) ^b									
At least one vaccination	4	0.260	265	1	0.748	712	1	0.818	835
BCG vaccination	3	0.716	265	0	0.916	712	-1	0.932	835
Modern family planning among women ages 15–49	2	0.798	1,329	6	0.046	3,690	5	0.050	4,341
Households' use of at least one bed net	14	0.000	1,000	-6	0.672	2,700	0	0.950	3,200
Total quality scores in health care facilities	22.92 ^b	0.000	49	15.88 ^b	0.062	130	17.24 ^b	0.062	159
INDIRECT OUTCOMES									
Households child birth in past twelve months	-5	0.002	1,000	-1	0.018	2,700	-2	0.040	3,200
Illness episodes, health care used when illness episodes for which care was used ($p = 0.014$) ^b	6	0.396	1,440	-1	0.960	3,770	2	0.750	4,555
Quality of care sufficient	-2	0.540	1,291	3	0.406	3,237	0	0.924	3,928
Drug availability sufficient	2	0.850	1,295	6	0.436	3,250	4	0.492	3,941
Personnel respectful	0	0.920	1,300	-3	0.534	3,256	-2	0.718	3,947
Waiting time reasonable	-3	0.666	1,299	-13	0.276	3,259	-12	0.318	3,950
Felt cured	2	0.476	1,294	11	0.048	3,241	9	0.012	3,932

SOURCE Authors' calculations. **NOTES** Results of ordinary least squares estimation. All models include province and time controls and the control variables as listed in Appendix 8 (see Note 21 in text). The phase II and pooled models for quality scores in health care facilities contain facility fixed effects. *p* values were adjusted for multiple outcomes testing and calculated using the bootstrapping method proposed in Cameron AC, et al., Bootstrap-based improvements for inference with clustered errors (see Note 25 in text). Statistical significance based on *p* values adjusted for multiple outcomes testing. ^aFamily-wise adjusted *p* value for an alpha of 5 percent based on Bonferroni correction with intervariable correlation adjustment. ^bCoefficient of the ordinary least squares estimation.

share of patients who felt cured.

Estimated performance-based financing effects in phase II were generally smaller compared to those in phase I (Exhibit 2). Performance-based financing increased the share of institutional deliveries by 14 percentage points, a relative increase of 19 percent, which is less than half of the increase found in phase I. No effect was found on the use of antenatal care in phase II. However, the use of modern family planning did significantly increase by 6 percentage points, a relative increase of 67 percent. No performance-based financing effect was found on bed-net use in phase II, unlike the effect found in phase I. The quality score increased by 16 percentage points, or 38 percent, which is a considerably smaller effect than found in phase I. Appendix 9²¹ shows that the effect on the total quality score is mainly driven by improvements in infrastructure and communication, in addition to the increased availability of family planning and drugs. We found no significant change in any of the five

measures for patient satisfaction.

Pooling the data shows that the overall effect of performance-based financing between 2006 and 2010 (Exhibit 2) implies a significant improvement in about half of the studied incentivized services. Effects on indirect outcomes are generally smaller than on the directly incentivized ones. Performance-based financing increased the share of women delivering in an institution by 22 percentage points, a relative increase of 36 percent, and the use of modern family planning services by 5 percentage points, a relative change of 55 percent. The overall facility quality score increased by 17 percentage points (relative change of 45 percent), and the share of patients reporting they felt cured increased by 9 percentage points (relative change of 12 percent). No significant effect was found on the other aspects related to the quality of care as reported by patients. We found no effects of performance-based financing on vaccination rates, the reported use of at least one bed net, or on the use of care when

ill. For most outcomes, there is no indication of heterogeneity of effects by poverty status (results available on request). Only for the use of health care when ill did we find the performance-based financing effect to be smaller for the poor.

Moving Forward

The experience in the first two phases of performance-based financing implementation in Burundi led the Ministry of Health to gradually introduce further alterations to the performance-based financing scheme, following the nationwide rollout. The main aims were to improve the verification of reported results; foster a more equitable distribution of outcomes; and enhance the quality of care. Below, we discuss these three changes as well as funding and sustainability of the scheme.

ALTERATIONS In the initial phase of the performance-based financing rollout, independent agencies (staffed by international nongovernmental organizations, or NGOs) were responsible for the contracting of health facilities and the verification of reported results and payments. The payment function has now been taken over by the national government. So-called *Comités Provincial de Vérification et de Validation* (Provincial Verification and Validation Committees) were developed to perform the contracting and verification functions. These committees are public-private partnerships comprising members from local government but also from civil society, provincial and district health management staff, international NGOs, and partners with technical expertise.

A second change relates to enhancing equity in health care use via two routes. First, so-called isolation bonuses are paid to health care facilities in rural, remote areas or with a relatively large share of their target population living below the poverty line. The higher per capita budgets should reduce staff shortages by attracting health workers from urban areas. Second, additional funding is provided to health facility managers for the provision of care to the poorest part of their target population.

A third modification relates to the measurement of quality, which initially focused on structure and process quality. The Ministry of Health noted satisfactory improvements in these quality measures. The ministry's subsequent aim is to strengthen other aspects of the quality of health care services. Beginning in 2014 the items on the quality checklist focus more on health outcomes and clinical aspects, aiming to move toward a full quality accreditation system, which is currently not in place.

FUNDING AND SUSTAINABILITY The initial im-

plementation of performance-based financing in phase I, inspired by earlier programs in Cambodia and Rwanda,^{30,31} was funded by aid agencies and international NGOs (including the Dutch NGO Cordaid). The Ministry of Health of Burundi is now providing the majority of funding for the national performance-based financing program, though reliance on funding from outside the country remains considerable. Performance-based financing sustainability seems secured because it is now recognized as a national strategy. The national government committed to allocate 1.4 percent of its budget to performance-based financing and related health financing strategies each year.

Discussion

The introduction of performance-based financing in Burundi improved the use of maternal care services and the quality of health care services during the period 2006–10. Examining the effect of performance-based financing on six of the twenty-three incentivized services, we found a positive effect on four of the six services in at least one of the implementation phases, as well as on the total quality score for health services. We found significant increases in institutional deliveries, antenatal care use (in phase I), modern family planning, and bed-net use (in phase I). The improvement in the total quality score in health care facilities based on external audits was large and significant but not confirmed by patient reports. The share of patients who felt cured after using health care increased significantly, though this outcome may be prone to reporting bias. No significant effects were found on the quantity of general health care used or on vaccinations in infants and pregnant women. We could not test for a performance-based financing effect on the seventeen other incentivized services that mostly relate to care for HIV, tuberculosis, and sexually transmittable diseases.

While some positive performance-based financing effects were obtained across the entire study period, effects were considerably larger in the early-adopting than the later-adopting provinces. The reasons for the lower effectiveness in the later period are unclear. Since institutional deliveries were lower at baseline for the early-adopting provinces, there may have been more room for improvement, but this does not explain the larger effects on other outcome measures. It could also be related to performance-based financing causing a steeper upward trend in phase I outcomes, creating a downward bias in our phase II estimates.

We did not find strong evidence of differential effects of performance-based financing across

socioeconomic groups, and the performance-based financing effects on the probability of using care when ill were even smaller for the poor. This suggests that a supply-side intervention such as performance-based financing without accompanying access incentives aimed at the poor is unlikely to improve equity. Outcomes that were not directly incentivized by performance-based financing payments showed less improvement compared to those directly incentivized.

RWANDA'S EXPERIENCE Our study findings can be compared to those of Paulin Basinga and colleagues,¹² who exploited the staggered rollout of performance-based financing in Rwanda to estimate its impact using difference-in-differences analysis. Rwanda is one of the few African countries with nationwide performance-based financing, and its neighboring location to Burundi makes it a suitable comparator. The Rwanda performance-based financing setup was similar, though subsidies to health care providers were slightly lower. The main design difference was that the control provinces received additional funding in Rwanda. The supply-side financing system also differed: Rwanda introduced performance-based financing within a system of community-based health insurance, while in Burundi user fees for deliveries and care for children younger than age five were removed. Basinga and colleagues¹² found a 23-percentage-point increase in the number of institutional deliveries in Rwanda—close to the 22-percentage-point increase we found in Burundi. They reported no significant impact of performance-based financing on tetanus vaccination or child immunization, in line with our findings. Neither study found a consistent effect on antenatal care use. The quality score in the Rwandese study is not directly comparable to ours, as it relates to

antenatal care, while the Burundi study evaluates a broad range of quality in health service delivery. However, both studies found the quality score to be the outcome measure showing the largest improvement.

The observed improvements in some of the incentivized services are likely to contribute to achieving the targets set by Millennium Development Goals 5 and 4 of reducing maternal and child mortality.³² World Bank Group President Jim Yong Kim recently announced that an additional \$700 million will be devoted to enhancing women and children's health through results-based financing, to help reach these Millennium Development Goal targets by 2015.³³

REMAINING QUESTIONS While our findings are encouraging, they also leave some remaining questions. The observed differences in effects between implementation waves call for further exploration of the relative contributions of the subcomponents of performance-based financing programs, such as the targeting of the vulnerable and the engagement of the community. We also cannot offer a conclusion on the effect of performance-based financing on the nonincentivized services, as that could not be studied with our data. Future research should also aim to identify effects of performance-based financing on health outcome measures such as maternal and child mortality. Also, further clarification is required on the issue of whether performance-based financing mainly affects health care use and quality through expanded facility resources or through a change in provider incentives. This would be essential to answer the questions of whether performance-based financing is a cost-effective intervention and whether its effects outweigh its additional administrative burden. ■

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Performance-Based Financing on the Use and Quality of Health Care in Burundi: An Impact Evaluation," based on an earlier version of this study, was published in *The Lancet* (vol. 318, no. 219) for the Global Health Metrics and Evaluation conference, in Seattle, Washington, June 17–19, 2013. The authors thank Jenny van de Weerd, Fenneke Hulshof, Piet Vroeg, Bruno Meessen, Owen O'Donnell, Stella Quimbo, Sven Neelsen, and Godelieve van Heteren for their input during a workshop, Performance-Based Financing, April 24, 2012, at Erasmus University

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NOTES

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Appendix 1: PBF payments for output indicators

Output indicator <i>j</i>	Payment in US dollar
Children 6 - 59 months receiving Vit A	0.05
Outpatient consultancy - new case	0.25
Antenatal care: new and standard visits	0.40
Diagnosis and treatment of STD	0.50
In patient bed day	0.50
Pregnant woman fully immunized	0.50
Small surgery intervention	0.50
Latrine newly constructed	0.70
Child treated after birth HIV mother	1.00
Family planning: referral of tubal ligation and vasectomy	1.00
HIV mother treated	1.00
Patient referred to hospital and feedback obtained	1.00
Pregnant woman counseled and tested for HIV	1.00
Person voluntary counseled and tested for HIV	1.00
Bed net distributed	1.50
Child under 1 completely immunized	1.50
HIV case diagnosed and referred	1.50
Family planning: new and re-attendants, oral & injectable	2.00
HIV mother referred to hospital	2.00
Institutional delivery by qualified staff	2.00
Family planning: implant or IUD	5.00
Patient diagnosed with TB (3 sputum checks)	10.00
TB patient correctly treated during 6 months	20.00

Source: Ministère de la Santé Publique¹⁵

In bold the six output indicators which are evaluated in this study.

Appendix 2: Sample sizes

		No PBF	PBF	Total
Households	Phase I	775	225	1000
	Phase II	1050	1650	2700
	Pooled	1550	1650	3200
Women who delivered in preceding year	Phase I	202	72	274
	Phase II	286	429	715
	Pooled	416	429	845
Infants	Phase I	192	73	265
	Phase II	282	430	712
	Pooled	405	430	835
Women 15y - 49y	Phase I	1026	303	1329
	Phase II	1443	2249	3692
	Pooled	2092	2249	4341
Illness episodes	Phase I	1115	325	1440
	Phase II	1411	2359	3770
	Pooled	2196	2359	4555
Health care facilities	Phase I	38	11	49
	Phase II	49	81	130
	Pooled	78	81	159

Appendix 3

QUESTIONNAIRE Final Version 22/09/06

QUALITY STUDY HEALTH FACILITIES

Interviewer explains the purpose of the visit and that the MOH aims to improve the health services.
Explain that confidentiality is assured. Visit is not an inspection but aims to improve the health system

Date: .. / .. / 2006	Name interviewer:	Province :
District:	Name Health Fac :	HF : public / relig / private
Pop Catchment Area:	Nbr of beds :	Nbr of qualified staff :
Condition of building? Good / more or less / bad		

A. GENERAL INDICATORS	Protocol respected	Protocol NOT respected
1. Availability of catchment area health map and displayed at the wall	1	0
2. Quarterly business plan (or action plan) of health facility <u>available and used</u>	1	0
3. Monthly technical meetings by health facility staff conducted of which a report produced and available	1	0
4. Referral documents are available	1	0
5. Radio or mobile phone system is available and functional for communication health staff and next referral level	1	0
6. Cost recovery tariffs are known and displayed for patients	2	0
7. Personnel sterilises the instruments according to the standards. <i>Autoclave available and utilized every day</i>	1	0
8. Waste is collected and put in appropriate containers <i>Availability of bins and safety box for needles</i>	1	0
9. Incineration done correctly - waste pit available	1	0
10. Presence of latrines in sufficient quantity and in good working condition	1	0
11. Cleanliness of the court <i>No waste or hazardous materials to be found in the yard</i>	1	0
TOTAL Points - 12 points maximum / 12	XXXXXX

B. Protocol - OUTPATIENT	Protocol respected	Protocol NOT respected
1. Correct numbers in the OPD register	1	0
2. Services available 24/24 hours, 7/7 days, - Check the OPD register: Last Sunday	1	0
3. Protocol displayed for the management of malaria	1	0
4. Satisfactory management of uncomplicated malaria Check the records of the last 5 cases (AS / AQ)	2	0
5. Satisfactory management of of severe malaria Check the records of last 2 cases (quinine injection)	1	0
6. Availability stethoscope / functional sphygmomanometer	2	0
7. Availability of functional thermometer	1	0
8. Availability of functional otoscope	1	0
9. Availability of functional weighing scale	1	0
TOTAL Points - 11 points maximum / 11 points	XXXXXX

C. Protocol for diagnosis and treatment - MATERNITY	Protocol respected	Protocol NOT respected
1. Availability of partogram	1	0
2. Taking blood pressure during childbirth <i>Filled in the partogram or the admission sheet</i>	1	0
3. Systematic measurement of the APGAR after childbirth <i>Filled in the maternity register</i>	1	0
4. Availability of a measuring tape (to measure height)	1	0
5. Availability of obstetric stethoscope	1	0
6. Delivery table in good condition (<i>functional feet rest</i>)	2	0
7. Availability of 2 obstetric sterilized boxes <i>Contain at least one scissor, two clamps, one needle holder</i>	1	0
8. Availability of functional baby weighing scale	1	0
9. Availability of a suction set (= manual or vacuum)	1	0
10. Availability bed nets in in-patient room	2	0
TOTAL Points - 12 points maximum / 12	XXXXXX

D. Protocol - FAMILY PLANNING	Protocol respected	Protocol NOT respected
1. Register FP available and well used	2	0
2. Oral and injectable contraceptive methods available in sufficient quantity (<i>at least 20 oral strips and 10 ampoules</i>)	2	0
3. IUDs available and in quantity (at least 5)	1	0
4. FP register available and well utilized (5 records) (<i>check sphygmomanometer, hepatomegaly, varicose veins, weight</i>)	2	0
5 Nurse calculates the expected number of women for FP in its catchment area	1	0
TOTAL Points - 8 points maximum / 8	XXXXXX

E. Protocole- VACCINATION – ANTENATAL CARE	Protocol respected	Protocol NOT respected
1. Availability DTC+Hib+Hep, BCG, Measles, Polio, Tetanus	1	0
2. Regular monitoring of the cold chain <i>Availability of books or sheet temperature (2 x day)</i>	1	0
3. Standards of vaccine storage <i>Available vaccines - VAR & VAP in freezer - Other vaccines in the refrigerator</i>	1	0
4 Stock notebooks EPI customers - <i>at least 10</i>	1	0
5. ANC Register available and well utilized – <i>at least 10</i>	2	0
6. Stock records ANC - <i>at least 25</i>	1	0
TOTAL Points - 7 points maximum / 7	XXXXXX

F. Diagnostic Protocol - LABORATORY	Protocol respected	Protocol NOT respected
1. Availability of functional centrifuge	1	0
2. Availability of a functional microscope - <i>Immersion oil - mirror or electricity - blades</i>	3	0
3. Availability GIEMSA	1	0
TOTAL Points - 5 points maximum / 5	XXXXXX

G. Availability of TRACER DRUGS Safety stock = Average Monthly Consumption / 2 = AMC / 2	AVAILABLE YES > AMC / 2	AVAILABLE NO < AMC / 2
1. Amoxicillin caps 250 mg	1	0
2. Artesinat tabs 50 mg – amodiaquine 200 mg	1	0
3. Cotrimoxazol tabs 480 mg	1	0
4. Diazepam 10 mg / 2ml - injectable	1	0
5. Mebendazol tabs 100 mg	1	0
6. Methergin amp 10 Units	1	0
7. Metronidazole tabs 250 mg	1	0
8. Paracetamol tabs 500 mg	1	0
9. Quinine tabs 500 mg	1	0
10. ORS Sachets	1	0
TOTAL Points - 10 points maximum / 10	XXXXXX

H. Availability of TRACER DRUGS Safety stock = Average Monthly Consumption / 2 = AMC / 2	AVAILABLE YES > AMC / 2	AVAILABLE NO < AMC / 2
1. Sterile gloves	1	0
2. Bandages	1	0
3. Glucose 500cc 5%	1	0
TOTAL Points - 3 points maximum / 3	XXXXXX

SCORE TOTAL / 68	XXXXXX
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*MAKE SURE ALL QUESTIONS ARE FILLED
Interviewer thanks the staff*

Appendix 4: Means for incentivized and indirect outcomes in PBF phase I and phase II provinces

	Main or additional outcome measure	Sample	Phase I provinces			Phase II provinces		
			2006	2008	2010	2006	2008	2010
<u>Incentivized outcomes</u>								
Maternal care								
		Women who delivered in preceding year						
	Institutional delivery (1/0)	Main	0.48	0.87	0.88	0.73	0.67	0.81
	More than one antenatal care visit (1/0)	Main	0.93	0.99	0.96	0.94	0.93	0.94
	More than one tetanus vaccination (1/0)	Main	0.83	0.90	0.62	0.83	0.85	0.72
Child care								
		Infants						
	At least one vaccination (1/0)	Main	0.95	0.98	0.95	0.93	0.93	0.93
	BCG vaccination (1/0)	Main	0.95	0.98	0.95	0.91	0.92	0.91
Family planning services								
		Women 15y - 49y						
	Modern family planning (1/0)	Main	0.09	0.08	0.12	0.09	0.06	0.15
Musquito bed nets								
		Households						
	Use of at least one bed net	Main	0.53	0.65	0.85	0.42	0.51	0.64
Quality scores in health care facilities								
		Health care facilities						
	Total quality score	Main	35.44	49.35	51.76	41.92	31.20	50.02
	<i>max. 68 points</i>		(6.49)	(11.73)	(7.58)	(8.93)	(7.39)	(6.50)
	Infrastructure and communication score	Additional	4.06	8.76	9.18	5.77	2.84	8.34
	<i>max. 12 points</i>		(1.91)	(2.82)	(2.21)	(2.42)	(2.07)	(1.89)
	Outpatient consultations score	Additional	6.13	8.82	8.94	8.08	6.04	8.91
	<i>max. 11 points</i>		(2.42)	(2.10)	(1.25)	(1.93)	(2.10)	(1.60)
	Maternal care score	Additional	6.75	9.12	9.18	8.85	5.96	8.53
	<i>max. 12 points</i>		(1.91)	(2.26)	(1.98)	(2.12)	(2.30)	(3.10)
	Family planning score	Additional	2.81	4.24	4.41	2.85	2.00	4.51
	<i>max. 8 points</i>		(2.32)	(2.61)	(3.06)	(2.58)	(2.40)	(2.50)
	Vaccinations score	Additional	3.13	4.47	5.94	5.62	2.80	4.79
	<i>max. 7 points</i>		(1.63)	(2.37)	(1.09)	(1.45)	(1.57)	(1.55)
	Laboratory services score	Additional	3.63	3.82	4.59	3.00	3.43	4.60
	<i>max. 5 points</i>		(1.59)	(1.74)	(1.00)	(1.96)	(1.78)	(0.95)
	Drug availability score	Additional	6.75	8.12	7.41	5.85	6.12	7.91
	<i>max. 10 points</i>		(1.88)	(1.83)	(3.34)	(2.48)	(2.49)	(1.97)
	Med consumable availability score	Additional	2.19	2.00	2.12	1.92	2.02	2.43
	<i>max. 3 points</i>		(0.91)	(1.32)	(1.22)	(1.04)	(0.97)	(0.71)
<u>Indirect outcomes</u>								
	Child birth in past 12 months (1/0)	Main	0.27	0.30	0.26	0.25	0.27	0.25
	Health care used when ill (1/0)	Main	0.86	0.91	0.88	0.89	0.87	0.85
Satisfaction with care used								
		Illness episodes for which care was used						
	Quality of care sufficient (1/0)	Main	0.94	0.88	0.95	0.87	0.84	0.93
	Drug availability sufficient (1/0)	Main	0.90	0.83	0.92	0.88	0.79	0.92
	Personnel respectful (1/0)	Main	0.86	0.83	0.95	0.91	0.85	0.93
	Waiting time reasonable (1/0)	Main	0.46	0.55	0.85	0.40	0.60	0.77
	Felt cured (1/0)	Main	0.76	0.65	0.67	0.75	0.60	0.74

Notes: Between brackets standard deviation for non-binary outcomes.

The number of observations in the specific samples (N) are shown in Appendix 2.

Appendix 5 Formal model description

Let \bar{Y}_{tp} represent the average value of the outcome of interest at time t in province p . We can examine the change in \bar{Y} in the phase I regions between 2006 and 2008 relative to the change in the control provinces (phase II):

$$\left(\bar{Y}_{2008I} - \bar{Y}_{2006I}\right) - \left(\bar{Y}_{2008II} - \bar{Y}_{2006II}\right) \quad (2)$$

Similarly, for the phase II regions, we can compare:

$$\left(\bar{Y}_{2010II} - \bar{Y}_{2008II}\right) - \left(\bar{Y}_{2010I} - \bar{Y}_{2008I}\right) \quad (3)$$

Note that in the second comparison, the phase I regions are being used as controls.

To control for other (observed) factors that influence the use and quality of health care, we estimate the health care use for individual i at time t in province p as follows:

$$Y_{ip} = T_t + P_p + PBF_{ip} + X_{ip} + \varepsilon_{ip} \quad (4)$$

The model includes year indicators (T_t) to capture the time trend in outcomes common to PBF and non-PBF provinces, and a full set of province effects (P_p) to capture time invariant differences. The interest lies in the effect of the PBF indicator (PBF_{ip}) which is switched on if the province p has PBF at time t . Controlling for time varying individual variables (X_{ip}) accounts for the differences in observable characteristics between PBF and non-PBF provinces. We assume that the error term (ε_{ip}) is normally distributed such that (4) is a linear model. We have confirmed robustness of our results to using a logistic model for binary outcomes.

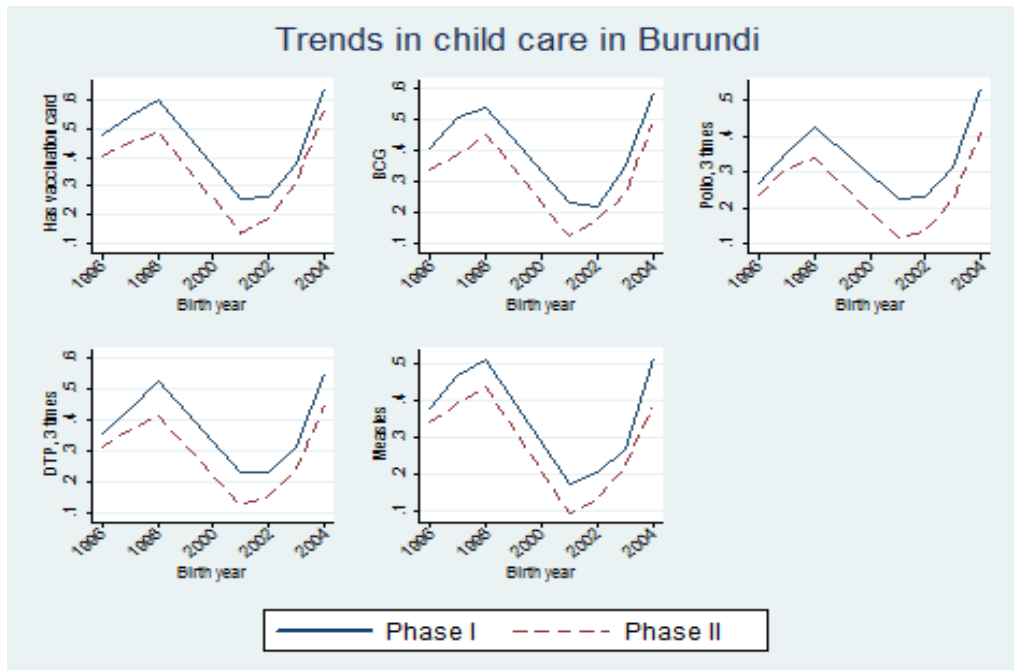
To account for the small number of clusters, we use the bootstrapping method proposed by Cameron et al.⁽²⁴⁾ to obtain statistical inference. To further account for possible type I error because of multiple hypothesis testing, we apply a Bonferroni correction that also accounts for the inter-variable correlation between the outcome variables in each of the three families

with multiple outcomes (Aker et al.⁽²⁵⁾ and Sankoh et al.⁽²⁶⁾). These correlations are fairly low for the family “women who delivered in preceding year” and the family “illness episodes for which care was used” (respectively 0.03-0.20 and 0.04-0.35) suggesting that the method proposed by Aker et al. performs reasonably well⁽²⁷⁾. The correlation for the remaining family is obviously much higher (0.95-0.97) because BCG vaccination is part of the outcome of having at least one vaccination. We calculate the family-wise adjusted p-value for an alpha of 5 percent and have added these (in italics) to Exhibit 2. Note that this correction only has a minor impact on the results.

Appendix 6: Characteristics by province at baseline

Province	Child mortality per 1000 live births	Poverty incidence (%)	Adults finished primary education (%)	Health care centres per 100.000 inhabitants	Doctors per 100.000 inhabitants
Bubanza	214	57.0	56.8	5.1	0.6
Cankuzo	147	67.7	41.3	8.0	1.5
Karuzi	154	68.9	65.8	3.6	1.7
Makamba	143	57.3	43.4	6.4	0.8
Gitega	137	68.2	53.8	5.5	0.7
Bururi	81	56.7	44.8	12.7	1.0
Muramvya	144	70.0	55.3	6.6	3.3
Rutana	190	72.9	52.4	11.3	0.7
Ruyigi	163	76.0	37.3	6.0	1.1
Bujumbura-mairie	102	28.7	57.7	n/a	n/a
Bujumbura-rural	134	64.3	56.8	n/a	n/a
Cibitoke	167	59.5	38.8	8.4	0.4
Kayanza	107	75.5	64.7	6.6	1.8
Kirundo	224	82.3	54.2	6.2	1.2
Muyinga	216	70.5	50.8	4.9	0.7
Mwaro	94	61.5	47.7	8.5	1.2
Ngozi	179	75.4	54.8	6.7	1.4
National	151	66.9	52.9	n/a	n/a
Sources:	Author's calculations based on MICS 2005 (N = 5819 children)	UNDP, 2010	Author's calculations based on MICS 2005 (N = 13864 adults)	Ministère de la Planification Centrale 2007	Ministère de la Planification Centrale 2007

Appendix 7: Trends in child care in Burundi



Appendix 8: Household level means for controls in PBF phase I and phase II provinces

	Phase I provinces			Phase II provinces		
	2006	2008	2010	2006	2008	2010
Household size	5.64	5.79	5.58	6.05	6.02	5.92
Low income	0.38	0.34	0.29	0.37	0.35	0.31
High income	0.38	0.29	0.40	0.29	0.26	0.40
Nr of girls below 1y	0.10	0.17	0.12	0.11	0.15	0.11
Nr of boys below 1y	0.14	0.14	0.13	0.16	0.12	0.13
Nr of girls 1y to 5y	0.49	0.46	0.52	0.47	0.52	0.50
Nr of boys 1y to 5y	0.51	0.58	0.59	0.59	0.52	0.53
Nr of girls 6y to 14y	0.86	0.70	0.70	0.94	0.87	0.83
Nr of boys 6y to 14y	0.78	0.81	0.60	0.94	0.85	0.76
Nr of women 15y to 49y	1.24	1.36	1.39	1.36	1.37	1.36
Nr of men 15y to 49y	1.13	1.26	1.10	1.11	1.25	1.23
Nr of women >49y	0.19	0.15	0.20	0.18	0.16	0.24
Nr of men >49y	0.20	0.17	0.23	0.21	0.20	0.22
All girls (6y-14y) in school	0.77	0.88	0.93	0.78	0.83	0.91
All boys (6y-14y) in school	0.81	0.83	0.95	0.81	0.83	0.90
Durable housing material	0.36	0.51	0.70	0.67	0.69	0.78
Access to clean water	0.48	0.81	0.90	0.90	0.88	0.83
Owens fertile land	0.67	0.57	0.37	0.67	0.57	0.35
Nr of illness episodes	1.78	1.54	1.54	1.70	1.48	1.61
Has health insurance	0.04	0.05	0.08	0.09	0.08	0.11
Female income earner	0.20	0.21	0.34	0.18	0.25	0.35
Married	0.84	0.79	0.72	0.85	0.79	0.73
Polygamy	0.08	0.06	0.07	0.03	0.04	0.04
Farmer	0.88	0.92	0.88	0.89	0.86	0.90

Appendix 9: OLS estimation of effects PBF on subitems of total quality score

	Phase I	p-value	N	Phase II	p-value	N	Pooled	p-value	N
Infrastructure and communication score	6.91**	0.000	49	4.86**	0.040	130	5.37**	0.008	159
Outpatient consultations score	2.77	0.354	49	2.64*	0.094	130	2.88**	0.004	159
Maternal care score	3.78	0.534	49	2.49	0.212	130	3.16*	0.070	159
Family planning score	2.35	0.522	49	2.25**	0.034	130	2.17*	0.056	159
Vaccinations score	2.92	0.144	49	0.59	0.628	130	1.63	0.292	159
Laboratory services score	0.92	0.584	49	0.33	0.326	130	0.32	0.452	159
Drug availability score	2.61	0.108	49	2.67**	0.014	130	1.88*	0.054	159
Med consumable availability score	0.67	0.268	49	0.06	0.854	130	-0.17	0.792	159

* p<0.10; ** p<0.05

Notes: All models include time controls and the control variables as listed in Appendix 8.

The phase II and pooled models also contain facility fixed effects.

p-values calculated using bootstrapping method proposed by Cameron et al.²⁴