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SORT IT SUPPLEMENT: POST-EBOLA RECOVERY IN WEST AFRICA

Performance-based financing contributes to the resilience of health services affected by the Liberian Ebola outbreak

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Setting: The Liberian counties of Bong, with performance-based financing (PBF) for all 36 public primary-care facilities, and Margibi, with no PBF for its 24 public primary-care facilities.

Objective: To compare whether specific maternal and child health indicators changed in the two counties during the pre-Ebola (2013), Ebola (2014) and post-Ebola (2015) disease outbreak periods from July to September each year.

Design: This was a cross-sectional study.

Results: For pregnant women, the numbers of antenatal visits, intermittent preventive malaria treatments, human immunodeficiency virus (HIV) tests and facility-based births with skilled attendants all fell during the Ebola period, with decreases being significantly more marked in Margibi County. Apart from HIV testing, which remained low in both counties, these indicators increased in the post-Ebola period, with increases significantly more marked in Bong than in Margibi. The number of childhood immunisations decreased significantly in Bong in the Ebola period compared with the pre-Ebola period, but increased to above pre-Ebola levels in the post-Ebola period. There were markedly larger decreases in childhood immunisations in Margibi County during the Ebola period, which remained significantly lower in the post-Ebola period compared with Bong County.

Conclusion: In a PBF-supported county, selected maternal and childhood health indicators showed less deterioration during Ebola and better recovery post-Ebola than in a non-PBF-supported county.

Performance-based financing (PBF) is a mechanism through which health providers are at least partially funded on the basis of their performance.[1] Although PBF is increasingly being discussed as a means of improving the quality of health care and health outcomes, the evidence to support this component of health systems strengthening is conflicting. A recent systematic review of 30 studies concluded that there was a lack of robust evidence to support PBF of individual health practitioners compared with other payment models.[2] Another systematic review of the impact of health systems strengthening on the coverage and quality of maternal health services in rural Rwanda, however, found that a combination of PBF and community-based health insurance was associated with improved output in terms of higher rates of deliveries with skilled birth attendants and higher rates of institutional deliveries.[3]

Liberia is one of a number of countries in West Africa that has been striving for several years to improve its poor health indicators. In 2009 the Ministry of Health (MoH), supported by the United States Agency for International Development (USAID), initiated a PBF scheme in the majority of its counties at the primary health care level with a view to improving poor health indicators related primarily to the Millennium Development Goals.[4]

In 2013, West Africa was hit by the outbreak of the Ebola virus disease (EVD), a severe, often fatal filovirus infection,[5] which started in Guinea and rapidly spread to neighbouring countries and beyond.[6,7] Liberia diagnosed its first case of EVD in late March 2014, and by June 2016 had reported 10 678 cases, with approximately 4810 associated deaths.[7] Among the reported cases, 372 health-care workers had confirmed EVD, of whom 184 died. On 9 May 2015, Liberia was declared free of Ebola by the World Health Organization. The country subsequently experienced a cluster of six cases in June 2015, was declared free of transmission again on 3 September, experienced another cluster of three cases in November, and was again declared Ebola free on 14 January 2016.[7]

The EVD outbreak caused severe disruptions in health services in Sierra Leone, Liberia and Guinea.[8] Health workers were asked to follow a 'no touch' policy, and invasive procedures, including blood tests, were discouraged. The lack of personal protective equipment and fear of contracting Ebola led to the abandonment and closure of health facilities,[9] and communities were reluctant to attend health facilities due to fear of contracting the disease.[10] Maternal and child health services suffered as a consequence, whereas before the Ebola outbreak considerable efforts had been made to improve performance, and success in antenatal care had been demonstrated.[11]

Strengthening primary health care through the PBF scheme may have allowed targeted health facilities to be more resilient in the face of the damaging effects of the Ebola outbreak and equipped them to recover more fully and rapidly after the outbreak ended. There is no published information available, however, to support this hypothesis.

One of the first counties in Liberia to start implementing PBF was Bong, selected due to its population size and its need for improved health services. Bong currently implements PBF in all its facilities, in contrast to Margibi, a neighbouring county that has not implemented the PBF scheme. A recent published study as-

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sessing maternal health indicators in Bong and Margibi counties showed that all maternal health indicators decreased from March to December 2014.[12] There was no information about child health indicators, however, and no comparisons were made with the pre-Ebola period, nor was any information provided for the post-Ebola period. We therefore decided to compare whether specific maternal and child health indicators focusing on antenatal care, maternal deliveries and childhood immunisations changed during the pre-Ebola, Ebola and post-Ebola periods in Bong and Margibi counties.

METHODS

Study design

This was a cross-sectional study of maternal and child health indicators at the primary health-care level in one PBF-supported county and one non PBF-supported county in Liberia using routinely collected aggregate data.

Setting

General setting

Liberia, a West African country bordered by Guinea, Sierra Leone, Ivory Coast and the Atlantic Ocean, has an estimated population of 4 million. The per capita gross national income is US $2012.[13] The country is divided administratively into 15 counties, which include 91 health districts. Medical services are provided by a mixture of public, private and non-governmental organisations (NGOs). There are 727 health facilities of all levels in the country.[14,15] The national health policy, introduced in 2007, provided a free package of health services to Liberian citizens that included communicable disease control, emergency care, maternal and newborn health and mental health. This package was broadened in 2011 to include service support for other infections and diseases. The health packages and delivery of health services are described more fully in the national policy and planning reports issued by the MoH.[14–16]

Study sites: performance-based financing supported and non-supported facilities

The PBF scheme began in a stepwise fashion in seven counties in 2009, after which it was extended to five additional counties.[17] PBF has focused on the provision of direct support for primary and secondary health services through performance-based subcontracts with hospital management and NGOs. The PBF scheme was transitioned into a direct government-to-government agreement with the MoH in 2012 through a 'fixed amount reimbursement agreement', with a focus on primary health care for mothers and children.

The main aim of PBF is to extend the coverage and improve the quality of essential health-care services, especially in the areas of maternal and child health. The core PBF scheme implemented at primary level in Liberia involves three processes: 1) contractual arrangements between the MoH and the county health team (contracting in); 2) contractual arrangements between the MoH and NGOs/civil society organisations (management contracting); and 3) performance agreements between the implementing partner and health facilities. Financial incentives are provided based on the attainment of measurable performance targets negotiated between service providers and the contracting agencies.[1]

Bong, one of 12 counties that has implemented PBF, was selected for this study. PBF was started in 16 primary health-care facilities in Bong in 2009, and was scaled up to all of the county's 36 facilities in 2011; it has been maintained at this level ever since. In counties implementing PBF, including Bong, an evaluation in 2012 and in 2013 showed that a number of indicators had improved, such as the proportion of pregnant women receiving secondary preventive malaria treatment (IPT2) and the proportion of deliveries conducted by skilled birth attendants in health facilities, and that there was more improvement in these indicators in PBF than in non-PBF facilities.[18] Some indicators did not improve, however, such as the proportion of pregnant women who tested positive for human immunodeficiency virus (HIV) infection and initiated antiretroviral therapy; shortages of essential drugs were thought to be the reason.[18]

Of the three counties that have never implemented the PBF scheme, Margibi was selected for the study due to its geographic proximity to Bong, its health service utilisation rate of 0.75, similar to that reported for Bong, and health facility characteristics that to some extent matched those of Bong (Table 1).

The EVD outbreak started in Bong on 4 July 2014, with the last case reported on 9 June 2015, while in Margibi it started on 3 March 2014, with the last case reported in August 2015. Other features of the Ebola outbreak in each county are shown in Table 1.

Maternal and child health care and PBF-supported interventions

All pregnant women are supposed to attend a health-care facility for four antenatal care visits, the second dose of intermittent presumptive treatment for malaria, HIV testing and institutional delivery with skilled birth attendants.[13,15] All four of these indicators are supported with measurable targets through the PBF scheme. Newborns should receive the following scheduled vaccinations: bacille Calmette-Guérin (BCG), oral polio vaccine (OPV), pentavalent (for diphtheria, tetanus, pertussis, hepatitis B and *Haemophilus influenzae* type b) and measles, monitored through the routine MoH framework. Measles vaccination is supported with measurable targets through the PBF scheme. Facilities compile cross-checked monthly reports for accuracy of key maternal and child health indicators, which are sent to the districts and counties with onward submission to the MoH for collation and entry into the district Health Information Management System (HMIS).

Study population

The study population included pregnant women attending antenatal clinics, maternal deliveries and children aged <1 year receiving scheduled immunisations in one PBF-supported and one non-PBF-supported county during a specific quarter (July–September) in three different years: pre-Ebola (2013), Ebola (2014) and post-Ebola (2015).

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Conflicts of interest: none declared.

TABLE 1 Characteristics of Bong County (with PBF) and Margibi County (without PBF) and the EVD outbreak in both counties

County	Population* *n*	Population living <10 km from health facility %	Public PHC facilities *n*	Accreditation score for county health service delivery in 2013† %	Ebola cases in county as of December 2014 *n* (/100 000)	HCWs diagnosed with Ebola *n*	HCWs diagnosed with Ebola who died *n* (%)	Health facilities that closed at some stage during the Ebola outbreak *n* (%)
Bong (PBF)	333 000	78	36‡	57	148 (44)	21	19 (90)	36 (100)
Margibi (non-PBF)	209 923	93	32	44	391 (187)	59	47 (80)	32 (100)

*2008 census.
†The accreditation score presents a way of assessing the national progress in implementation of the Essential Package of Health Services, an operational document developed to assess health services and support systems, including quality. The scoring is based on four levels of implementation, with a score of 70% indicating that health services are implementing the full package.
‡Including one faith-based facility.
PBF = performance-based financing; EVD = Ebola virus disease; PHC = primary health care; HCW = health-care worker.

Data variables and sources of data

The data variables for the quarterly period (July–September) in each of the three years for each county included: 1) for antenatal care, the number of patients attending their first antenatal care visit (ANC1), the number attending four antenatal care visits (ANC4), the number receiving IPT2, and the number of mothers tested for HIV; 2) for maternal deliveries, normal deliveries at health facility level attended by skilled birth attendants; and 3) for childhood immunisations <1 year of age, BCG, three doses of OPV (OPV3), three doses of pentavalent vaccine (Penta-3), measles and full immunisation. The source of data was the HMIS at the MoH.

Analysis and statistics

Data were extracted to an Excel file (Microsoft Corp, Redmond, WA, USA) and a descriptive analysis was performed. Comparisons were made between Bong and Margibi counties during the pre-Ebola, Ebola and post-Ebola periods using the χ^2 test, assessing the percentage changes in the Ebola and post-Ebola periods with the pre-Ebola period as baseline. Levels of significance were set at 5%. Open Epi v.2.3 (Emory University, Atlanta, GA, USA) was used to perform the χ^2 test and assess significance.

Ethics approval

Approval for this study was obtained from the Pacific Institute for Research and Evaluation Ethics Committee, University of Liberia (Monrovia) and the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease (Paris, France). Due to the use of aggregate data, informed patient consent was not required.

RESULTS

Antenatal care

Table 2 shows the antenatal care indicators in Bong and Margibi counties. In Bong, the numbers for antenatal attendance, intermittent presumptive malaria treatment and HIV testing all decreased markedly in the Ebola vs. the pre-Ebola period. With the exception of HIV testing, which remained low, all of these numbers increased to above pre-Ebola levels in the post-Ebola period. In Margibi, there were significantly greater decreases in all these parameters in the Ebola period. In the post-Ebola period there were variations, with ANC1 and IPT2 returning to above pre-Ebola levels, while ANC4 and HIV testing remained lower than in the pre-Ebola period.

Facility-based births with skilled attendants and birth outcomes

Table 3 shows the number of facility-based births with skilled attendants in Bong and Margibi counties. In Bong, facility-based

TABLE 2 Antenatal care in Bong County (with PBF) and Margibi County (without PBF) between July and September during the pre-Ebola (2013), Ebola (2014) and post-Ebola (2015) periods

	Bong County (with PBF)					Margibi County (without PBF)				
	Pre-Ebola	During Ebola		Post-Ebola		Pre-Ebola	During Ebola		Post-Ebola	
ANC	*n*	*n*	% change*	*n*	% change*	*n*	*n*	% change*	*n*	% change*
ANC1†	4107	1912	–53‡	4357	+6§	1961	707	–64‡	3229	+65§
ANC4¶#	2636	1792	–32‡	3681	+40§	1692	620	–63‡	1118	–34§
IPT2#**	2426	1647	–32‡	3487	+44	850	284	–67‡	1065	+25
HIV testing#††	2739	1337	–51‡	1409	–49	1906	271	–86‡	955	–50

*Using pre-Ebola period data as reference.
†First ANC visit attended.
‡$P < 0.001$ comparing the change from the Ebola period to the pre-Ebola period between Bong and Margibi counties.
§$P < 0.001$ comparing the change from the post-Ebola period to the pre-Ebola period between Bong and Margibi counties.
¶Four ANC visits attended.
#Supported by the PBF scheme in Bong County.
**Second dose of intermittent presumptive treatment for malaria received by the mother.
††Mothers tested during ANC.
PBF = performance-based financing; ANC = antenatal care; HIV = human immunodeficiency virus.

TABLE 3 Maternal deliveries in Bong County (with PBF) and Margibi County (without PFB) between July and September during the pre-Ebola (2013), Ebola (2014) and post-Ebola (2015) periods

	Bong County (with PBF)					Margibi County (without PBF)				
	Pre-Ebola	During Ebola		Post-Ebola		Pre-Ebola	During Ebola		Post-Ebola	
Maternal deliveries	*n*	*n*	% change*	*n*	% change*	*n*	*n*	% change*	*n*	% change*
Facility births with skilled attendants†	2216	1852	–16‡	3154	+42§	1035	395	–62‡	890	–14§

*Using pre-Ebola period data as reference.
†Supported by the PBF scheme in Bong County.
‡$P < 0.001$ comparing the change from the Ebola period to the pre-Ebola period between Bong and Margibi counties.
§$P < 0.001$ comparing the change from the post-Ebola period to the pre-Ebola period between Bong and Margibi counties.
PBF = performance-based financing.

births with skilled birth attendants decreased in the Ebola period compared with the pre-Ebola period, but increased to above pre-Ebola levels in the post-Ebola period. The decreases in births with skilled attendants were significantly more marked in Margibi County, and did not return to pre-Ebola levels in the post-Ebola period.

Childhood immunisations

Table 4 shows immunisations for children aged <1 year in Bong and Margibi counties. In Bong, all of these parameters decreased markedly in the Ebola period compared with the pre-Ebola period, but increased to above pre-Ebola levels in the post-Ebola period. In Margibi, there were significantly greater decreases in all these parameters in the Ebola period, which, compared with Bong, remained significantly lower in the post-Ebola period.

DISCUSSION

This is the first study in Liberia to assess whether maternal and child heath indicators for antenatal care, maternal deliveries and child immunisations were more resilient during and after the EVD outbreak than they were before the outbreak in Bong, a PBF-supported county, compared with Margibi, a non-PBF-supported county. In both counties, all indicators decreased during the Ebola period, but these decreases were significantly more marked in Margibi than in Bong. In the post-Ebola period in Bong, key indicators, such as pregnant women attending four antenatal visits and receiving IPT2 for malaria, facility-based births with a skilled attendant and childhood immunisations, all recovered to above the pre-Ebola levels. In contrast, in Margibi, while there was recovery of these indicators, the levels in general remained below those of the pre-Ebola period. The exception to this was HIV testing for pregnant women, which decreased markedly in the Ebola period in both counties and remained low post-Ebola.

The strengths of this study are as follows: 1) the data for the indicators were collected from all public health facilities in each county; 2) the selection of the counties of Bong, with all public health facilities implementing PBF, and neighbouring Margibi County, with no PBF; 3) the selection of the July–September quarter of 2014, as this was when the Ebola outbreak in Liberia was reaching its peak, and comparable quarters before and after, equating to the pre-Ebola and post-Ebola periods; and 4) study conduct and reporting followed the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines and sound ethics principles for observational operational research.[19,20]

There were three main limitations. First, despite attempts to match the two counties, there were differences with regard to health facilities and services; Save the Children and other partners also provided differing levels of support to health facilities in both counties from September 2014 onwards.[12] There were, however,

TABLE 4 Immunisations among children aged <1 year in Bong County (with PBF) and Margibi County (without PFB) between July and September during the pre-Ebola (2013), Ebola (2014) and post-Ebola (2015) periods

	Bong County (with PBF)					Margibi County (without PBF)				
	Pre-Ebola	During Ebola		Post-Ebola		Pre-Ebola	During Ebola		Post-Ebola	
Vaccination	*n*	*n*	% change*	*n*	% change*	*n*	*n*	% change*	*n*	% change*
BCG	3675	2421	–34†	4338	+18‡	2028	600	–70†	1957	–4‡
OPV3§	3520	2101	–40†	3836	+9‡	1684	354	–79†	1525	–9‡
Penta-3¶	3520	2101	–40†	3844	+9‡	1684	351	–79†	1532	–9‡
Measles#	3131	1799	–43†	3616	+15‡	1476	290	–80†	1283	–13‡
Fully immunised	3133	1616	–48†	3462	+11‡	1459	286	–80†	1272	–13‡

*Using pre-Ebola period data as reference.
†$P < 0.001$ comparing the change from the Ebola period to the pre-Ebola period between Bong and Margibi counties.
‡$P < 0.001$ comparing the change from the post-Ebola period to the pre-Ebola period between Bong and Margibi counties.
§Three doses of OPV.
¶Three doses of pentavalent vaccine.
#Supported by the PBF scheme in Bong county.
PBF = performance-based financing; BCG = bacille Calmette-Guérin; OPV = oral polio vaccination.

similar tribal characteristics between the people living in both counties, with intermarriages between residents of the two counties, the same dominant local language (Kpelle), and similar health service utilisation rates, of 0.75, at the time of the study. Margibi County had a more severe Ebola outbreak than Bong, however, in terms of numbers of cases and affected health workers. Second, as reported secondary programme data were used for the analyses, there may be inaccuracies and missing information, particularly as there was limited supervision during the Ebola outbreak. Third, we were only able to provide absolute numbers for women attending antenatal clinics or children receiving immunisations, as the HMIS did not provide any denominators, such as the number of children eligible for vaccination, to allow us to look at proportions.

We can find no other published studies on the effect of the Ebola outbreak or a similar health emergency on PBF schemes. While a recent systematic review focusing on low- and middle-income countries came to the conclusion that stronger empirical evidence is needed on whether or not PBF is cost-effective,[21] there are reports of PBF schemes benefiting health service delivery in hard-to-reach areas in Rwanda and Burundi and the conflict setting of the Democratic Republic of Congo.[3,22–24] This being said, we do not really know why Bong County performed better than Margibi County and whether this had anything to do with PBF. Margibi appeared to have a more severe Ebola outbreak than Bong and, although the two counties were matched in some respects, they also differed in others, as discussed above. PBF-related reasons for the differences in Bong might include financial incentives linked to pre-determined targets that had to be achieved within a given time period, contractual obligations of health facilities to implement the necessary activities and, because of these contracts, a likelihood of better continuity in the availability of skilled health workers, drugs and consumables during the Ebola outbreak. There are, however, many confounding factors. Childhood immunisation rates, for example, are dependent on vaccine stocks and maintenance of the cold chain. In one Nigerian study, immunisation rates were not significantly better under a PBF scheme.[25] One area that did not improve in either Bong or Margibi counties was HIV testing, which may have been due to stock-outs of HIV rapid test kits,[18] or the adoption of the 'no touch' policy, which discouraged fingerprick blood testing. In future outbreaks, consideration should be given to alternative methods of HIV testing, such as oral salivary test kits.[26]

In conclusion, in a PBF-supported county, selected maternal and childhood health indicators, such as pregnant women attending antenatal care four times, giving birth in a health facility with a skilled attendant and children aged <1 year receiving their immunisations, showed less deterioration during the Ebola outbreak and better recovery post-Ebola compared with a non–PBF-supported county. HIV testing was the exception to this, with services badly affected during and after the Ebola epidemic. More in-depth, qualitative research is needed to better understand which components of the PBF scheme were associated with this resilience.

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Contexte : Deux contés du Liberia : Bong, avec un financement basé sur la performance (PBF) dans les 36 structures publiques de soins de santé primaires, et Margibi, qui n'a pas de PBF dans ses 24 structures publiques de soins de santé primaires.
Objectif : Comparer les deux contés et voir si les indicateurs spécifiques maternels et enfantins ont changé pendant les périodes avant Ebola (2013), pendant Ebola (2014) et après Ebola (2015) de juillet à septembre de chaque année.
Schéma : Une étude transversale.
Résultats : Chez les femmes enceintes, le nombre de consultations prénatales, de traitement préventif intermittent du paludisme, de tests pour le virus immunodéficience humaine (VIH) et de naissances dans des structures de santé avec du personnel qualifié, ont tous diminué pendant la période Ebola, avec un déclin significativement plus marqué à Margibi qu'à Bong. En dehors du test VIH, qui est resté faible dans les deux contés, ces indicateurs ont augmenté dans la période post-Ebola, avec des augmentations significativement plus marquées à Bong qu'à Margibi. Le nombre de vaccinations des enfants a diminué de façon marquée à Bong pendant la période Ebola comparée à la période pré-Ebola, mais il est revenu à un niveau supérieur à celui de la période pré-Ebola après l'épidémie d'Ebola. La diminution significative de la vaccination des enfants a été plus importante à Margibi pendant l'épidémie et est restée significativement plus faible après Ebola par comparaison avec Bong.
Conclusion : Dans un conté soutenu par un PBF, plusieurs indicateurs de santé de la mère et de l'enfant ont démontré une moindre détérioration pendant la période Ebola et une meilleure reprise après Ebola par comparaison avec un conté non soutenu par ce type de financement.

Marco de referencia: Dos condados en Liberia: Bong, donde el financiamiento de los 36 establecimientos de atención primaria de salud se basa en el desempeño (PBF) y Margibi donde el financiamiento de los 24 establecimientos de atención primaria no depende del PBF.
Objetivo: Evaluar comparativamente si los indicadores específicos de la salud maternoinfantil en ambos condados se modificaron durante el período anterior a la epidemia por enfermedad del Ébola (2013), el período epidémico (2014) y el período posterior al mismo (2015) de julio a septiembre de cada año.
Método: Un estudio transversal.
Resultados: En las embarazadas, el número de consultas prenatales, tratamientos preventivos antipalúdicos intermitentes, pruebas diagnósticas del virus de la inmunodeficiencia humana (VIH) y de partos institucionales atendidos por profesionales competentes disminuyeron durante el período de epidemia de enfermedad del Ébola, y estas disminuciones fueron más notables en Margibi que en Bong. Aparte de la prueba diagnóstica del VIH, que permaneció baja en ambos condados, estos indicadores aumentaron en el período posterior a la epidemia del Ébola y los aumentos fueron mayores en Bong que en Margibi. El número de vacunaciones en los niños disminuyó de manera notable en Bong durante la epidemia, en comparación con el período anterior a la misma, pero esta cifra aumentó después de la epidemia hasta valores superiores a los del período anterior. La disminución de las vacunaciones a los niños fue significativamente mayor en Margibi durante el período epidémico y las cifras permanecieron notablemente inferiores después del mismo, en comparación con las cifras obtenidas en Bong.
Conclusión: En un condado con PBF, los indicadores específicos de la salud maternoinfantil exhibieron un menor deterioro durante la epidemia de enfermedad del Ébola y su recuperación fue mayor después de la epidemia que en un condado cuyo financiamiento de los establecimientos de atención sanitaria no depende del desempeño.

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