Private Sector Provision of Oral Rehydration Therapy for Child Diarrhea in Sub-Saharan Africa

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Abstract. Although diarrheal mortality is cheaply preventable with oral rehydration therapy (ORT), over 700,000 children die of diarrhea annually and many health providers fail to treat diarrheal cases with ORT. Provision of ORT may differ between for-profit and public providers. This study used Demographic and Health Survey data from 19,059 children across 29 countries in sub-Saharan Africa from 2003 to 2011 to measure differences in child diarrhea treatment between private for-profit and public health providers. Differences in treatment provision were estimated using probit regression models controlling for key confounders. For-profit providers were 15% points less likely to provide ORT (95% confidence interval [CI] 13–17) than public providers and 12% points more likely to provide other treatments (95% CI 10–15). These disparities in ORT provision were more pronounced for poorer children in rural areas. As private healthcare in sub-Saharan Africa continues to expand, interventions to increase private sector provision of ORT should be explored.

INTRODUCTION

Diarrheal diseases are the second leading cause of death for children < 5 years of age with roughly 700,000 deaths annually.¹ Nearly all of these deaths are from dehydration, which is cheaply preventable through the use of oral rehydration salts (ORS) or other forms of oral rehydration therapy (ORT).^{2–6} ORS has been lauded as one of the most important medical advances of the 20th century and since 1980, when ORS became widely available, there has been more than a two-thirds reduction in diarrheal mortality for children < 5 years of age.^{7,8} As a result, ORS is recommended for all cases of child diarrhea regardless of illness severity.⁹

Despite the effectiveness of ORS in preventing diarrheal mortality, usage rates remain dangerously low, particularly in sub-Saharan Africa (SSA).^{8,10–13} There are several cultural and financial barriers that may lead health care providers across the developing world to underuse ORS. For instance, providers who directly dispense medicines to patients may prefer to sell more expensive treatments, such as antibiotics, that generate larger profits than ORS^{14–16}; ORS generates little profit at < 50 cents (U.S. dollars [USD]) per treatment course. The more expensive treatments do not combat dehydration, and some are even harmful, leaving the child vulnerable to death. Similarly, although ORS effectively treats the dehydration resulting from diarrhea, it does not reduce the volume of diarrhea. This instills a false perception that ORS is not efficacious leading to a preference for more expensive medicines believed to be more beneficial.^{17–19}

It is possible that barriers to using ORS differ across private and public providers. Prior studies using data mainly from the 1980s and 1990s show that private providers are less likely than public providers to provide ORS.^{20–22} Survey data from several countries in SSA show that ORS is less likely to be available in private facilities compared with public facilities.²³ However, important gaps remain in our understanding of public–private differences in diarrheal treatment. For example, none of the prior studies distinguish between for-profit and not-for-profit private providers; providers in these two sectors are likely to be driven by vastly different incentives.

It is also unclear the extent to which public–private differences in ORS provision are confounded by differences in patient characteristics (such as socioeconomic status) or differences in facility characteristics (such as level or scale of operation). With the exception of an 18-year-old study from Egypt,²¹ all prior studies fail to take into account any confounding factors that could bias the estimates. Finally, because SSA accounts for a disproportionate share of childhood mortality and that several SSA countries have a robust but diverse private sector with differences in quality as well as government oversight, there are no recent studies evaluating the role of the private sector in low take-up of ORS in SSA.^{24,25}

This study used data from 29 countries in sub-Saharan Africa for the years 2003–2011 to provide a fresh examination of public–private differences in diarrheal treatment. We hypothesized that private for-profit providers compared with public providers would be less likely to use ORS and more likely to use unnecessary treatments. We also hypothesized that these public–private disparities in ORS provision would be more pronounced for poorer children and children in rural areas, who are also the most vulnerable to diarrheal mortality.

METHODS

Data and study sample. We used Demographic and Health Survey (DHS) data for 29 countries in SSA from 2003 to 2011 (see Table 1). The DHSs are nationally representative household surveys that provide data on population, health, and nutrition. We used child-level DHS data (aged 0–59 months), and included only children who were reported by their mother as having had a diarrhea episode in the 2 weeks before the survey and sought treatment from health providers including hospitals, clinics, pharmacies, mobile clinics, and community health workers. We excluded children where treatment was sought from a traditional healer or a non-medical facility. We also excluded children who sought treatment from more than one facility. Two percent of the remaining observations were omitted as a result of missing values on key variables. These eligibility restrictions resulted in a final sample of 19,059 children.

Variables and measurement. *Dependent variables:* types of diarrheal treatment. Appropriate diarrheal treatment includes some form of ORT, regardless of illness severity.⁹ We distinguished between three types of diarrheal treatment and created

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TABLE 1
DHS surveys used

Country	Year(s) used	N
Benin	2006	293
Burkina Faso	2003	312
Burundi	2010	1006
Cameroon	2004	255
Chad	2004	207
Congo (Brazzaville)	2005	154
Congo (DRC)	2007	391
Ethiopia	2005, 2011	931
Ghana	2003, 2008	553
Guinea	2005	204
Kenya	2003, 2008	759
Lesotho	2004, 2009	335
Liberia	2007	614
Madagascar	2004	164
Malawi	2004, 2010	2,732
Mali	2006	231
Mozambique	2003	567
Namibia	2007	294
Niger	2006	307
Nigeria	2003, 2008	1,630
Rwanda	2005, 2008, 2010	871
Sao Tome and Principe	2009	118
Senegal	2005, 2011	1,275
Sierra Leone	2008	276
Swaziland	2007	232
Tanzania	2005, 2010	902
Uganda	2006, 2011	2,548
Zambia	2007	533
Zimbabwe	2006, 2011	365
Total	2003–2011	19,059

binary variables to indicate each treatment choice. The first represented whether the child was treated with ORS. The second represented whether a child received ORS or “recommended home fluids.” The recommended home fluid is a solution that contains similar ingredients as ORS and is recommended as a valid substitute.²⁶ We defined this broader category as ORT. The third represented whether the child received other treatments and *no* ORT. In some cases other treatments can be provided in compliment to ORT; however, besides intravenous fluids† no treatments should be provided in place of ORT even if the child does not show signs of dehydration.²⁶ This variable was set to one if the mother reported receiving any other treatment without ORT. The “other treatments” category included all remaining non-ORT treatments reported in the DHS, which consisted of pills/syrups, antibiotics, injections, herbal remedy, antidiarrheal medicines, and zinc.‡

Key independent variable: facility ownership. The DHS asked mothers what type of facility each child visited for diarrheal care. We used this information to identify children that went to private for-profit providers, public providers, and non-governmental organizations (NGO). We separately analyzed private NGO providers as they might have had different

incentives for providing ORS compared with private for-profit providers.

Analysis approach. *Public versus private treatment of diarrhea.* We used probit models to assess the relationship between provider ownership and the probability of receiving ORS, ORT, or other treatments. We controlled for a range of child, family, facility, and geographic confounders that may have affected both facility choice and the probability of receiving different types of diarrheal treatment.

At the child or family level we controlled for demographics, child health, sources of drinking water, and socioeconomic status. Demographic controls included child’s age in months, child’s age squared, child’s gender, mother’s age, mother’s age squared, mother’s education, whether a woman was the head of the household, and number of children in the family. We controlled for socioeconomic status by using quintiles of the DHS wealth index, a composite measure of a household’s cumulative living standard, which was calculated using principal components analysis at the national level by DHS administrators using data on a household’s ownership of selected assets.²⁷ Controls for child health included whether the child had a cough or fever in addition to diarrhea, height-for-age (a proxy for stunting), and weight-for-age (a proxy for underweight). We controlled for household drinking water source, because access to clean water may affect dehydration. We controlled for facility type because the composition of facility types may have been different between the private and public sectors. For example, most pharmacies are privately owned and have been shown to have low ORS provision rates relative to other facility types.^{19,22} We controlled for geographic confounders by including a rural/urban indicator variable (defined by the DHS administrators) and a set of dummy variables for each region within a country for each year. Finally, we controlled for secular trends by including a set of dummy variables for each survey year.

We used the model to estimate the probability that a child received each treatment category if they visited a for-profit private facility or a public facility while holding all other factors constant. We reported the average marginal effect of going to a for-profit private facility relative to a public facility. Standard errors were clustered at the country level and were estimated using 500 clustered bootstrap samples. In accordance with DHS recommendations, we did not use sampling weights in the regression models presented.²⁸ However, because there is some debate on this issue, we also ran all analyses presented in the work using sampling weights.

Wealth and rural heterogeneity. To examine heterogeneous effects of seeking care at the for-profit private sector by socioeconomic status, we assessed differences in for-profit private sector treatment provision to poor children relative to wealthy children and to rural children relative to urban children. For the former, we constructed terms that interacted the for-profit private variable with binary variables that represented each tercile of the wealth index. For the latter, we interacted the rural/urban variable with the for-profit private variable. We then included these interaction terms in our probit regression models.

Sensitivity analysis. We conducted multiple sensitivity analyses to check for the robustness of our results. First, we conducted a propensity score matching analysis by estimating the probability of going to the for-profit private sector (the propensity score) for each child based on all controls we included in the model. We then matched children taken to

† Intravenous fluids were received by 0.07% of our sample and all these children also received ORS.

‡ Although Zinc is recommended for child diarrhea, it should be accompanied by ORS even if the child is not dehydrated. Identification of zinc as a treatment option was only available in recent survey years and take-up in those years was extremely low, which is why we do not include a zinc + ORS combination as a dependent variable for our analysis.

the private sector to children taken to the public sector based on the propensity score. To maximize the matched sample size, we chose the largest caliper that still resulted in balance across all variables between the private sector group and the propensity score matched group. This ensured private sector children were comparable to the public sector children to whom they were matched. Using this process, we found a public provider match for 2,126 (47%) children that visited a for-profit private provider, resulting in a matched sample of 4,252 children. We then ran the same probit models and prediction process as described previously using this matched sample.

Next, we controlled for the influence of possible outlier countries in two ways. First, we tested if our findings held within each country individually. Second, we excluded each country individually and re-estimated our model. Any large change in the private sector effect with exclusion of any one country indicates the effect may have been driven by an outlier country.

Finally, we constrained our analysis to only children who sought treatment from a hospital or clinic—government hospitals and government health posts from the public sector, private hospitals/clinics from the private sector, and mission hospitals from the NGO sector. This accounted for the possibility that the compositional differences in facility types across the sectors may have biased our results.

RESULTS

Table 2 presents the distribution of facility types visited for diarrheal treatment. Seventy-one percent visited public facilities, 24% visited for-profit private facilities, and 5% visited NGO facilities. Generally, private providers in SSA are pharmacies or small clinics run by a single doctor, whereas public providers are hospitals or larger scale clinics. This is reflected in Table 2, which shows that the public facilities most commonly visited by children in our sample were health centers

TABLE 2
Distribution of facility types used for diarrheal treatment

Facility type	Frequency	Total % within sector %
Public	13,538	71%
Dispensary	434	3%
Government community pharmacy	70	1%
Government hospital	2,677	20%
Government health center	7,450	55%
Government health post	1,989	15%
Government mobile clinic	174	1%
Government community health worker	378	3%
Other public sector	203	2%
Government Maternity Home	163	1%
For-profit private	4,510	24%
Private hospital/clinic	2,255	50%
Pharmacy	1,668	37%
Private doctor	199	4%
Private mobile clinic	206	5%
Private maternity home	15	0%
Other private sector	167	4%
Non-governmental organization (NGO)	1011	5%
NGO community health worker	205	20%
Mission hospital	546	54%
NGO health facility	260	26%
Total	19,059	

TABLE 3

Summary statistics of child characteristics by ownership type of facility where treatment was sought

Dependent variable	For-profit private	Public
Oral rehydration salts (ORS)	44%***	68%
Oral rehydration therapy (ORT)	50%***	73%
Other treatments	37%***	20%
Rural	68%	76%
Age of child (months)	23.5***	22.2
Number of children in household	2.1	2.1
Age of mother	28.3	28.0
Female household head	20%	20%
Education of mother		
No education	30%	38%
Primary	49%	46%
Secondary	21%**	16%
Health of child		
Fever	55%	56%
Cough	51%	48%
Severely stunted	9%	11%
Moderately stunted	15%**	22%
Severely underweight	5%	6%
Moderately underweight	13%	15%
Source of water		
Piped water	26%	27%
Protected well/borehole	36%	30%
Unprotected well/natural source	38%	43%
Wealth status		
Poorest	21%**	25%
Poorer	19%	21%
Middle	18%***	21%
Richer	19%	18%
Richest	23%***	15%

Statistical significance is assessed using ordinary least squares, regressing each dependent variable on for-profit private and non-governmental organization (NGO) with the public sector as the reference, thus testing whether characteristics of for-profit private and NGO characteristics are statistically different from public sector characteristics.

*** $P < 0.01$, ** $P < 0.05$, standard errors are clustered at the country level.

and hospitals, whereas the for-profit private facilities most commonly visited were hospitals/clinics and pharmacies.

Table 3 presents means of outcome variables and covariates by whether the child visited a for-profit private, public, or NGO provider. Children that visited for-profit providers were less likely to receive ORS and ORT, and more likely to receive other treatments relative to public providers. In general, the characteristics of children who visited public and for-profit private providers were similar with some notable exceptions; children that went to the for-profit private sector had mothers with more education, were from wealthier households, and were slightly less likely to be stunted relative to children that visited the public sector.

Table 4 presents the predicted probabilities of receiving each treatment type for the public and for-profit private sector after adjusting for confounders. Because we are mainly

TABLE 4
Probability of treatment by ownership type

	For-profit private	Public	Difference*
Oral rehydration salts (ORS)	51.1%	65.7%	-14.6%***
Oral rehydration therapy (ORT)	55.7%	70.8%	-15.1%***
Other treatments	33.1%	20.5%	12.6%***

* Differences are average marginal effects.

Probabilities are predicted from probit regressions, each controlling for child age, child age squared, sex of child, child health, mother's age, mother's age squared, number of children in the household, if the mother was the head of the household, access to clean water, wealth, rural/urban, facility type, country-region, and year.

*** $P < 0.01$. Bootstrap standard errors are estimated with 500 iterations and are clustered at the country level.
N = 19,059.

TABLE 5
Probability of receiving treatment by wealth tercile

	Oral rehydration salts (ORS)			Oral rehydration therapy (ORT)			Other treatments		
	Private	Public	Difference	Private	Public	Difference	Private	Public	Difference
Poor	48%	64%	-16.5%***++	51%	68%	-16.9%***++	36%	21%	14.6%***+++
Middle	50%	67%	-16.5%***++	56%	71%	-15.4%***+	33%	21%	12.9%***+
Rich	54%	66%	-12.3%***	59%	71%	-12.3%***	30%	21%	9.7%***

Probabilities are predicted from probit regressions that include wealth tercile by private interaction terms. Each regression controls for child age, child age squared, child health, mother's age, mother's age squared, number of children in the household, if the mother was the head of the household, access to clean water, wealth, rural/urban, facility type, country-region, and year.

*** $P < 0.01$ = significance of the difference between public and private provision rates for each wealth group.

+++ $P < 0.01$, ++ $P < 0.05$, + $P < 0.1$ = significance of the difference of the public-private difference for poor and middle wealth groups relative to the rich group. Bootstrap standard errors are estimated with 500 iterations and are clustered at the country level.

interested in differences between public and for-profit private providers, we did not present NGO comparisons. The model predicted the for-profit private sector was 14.6% points less likely to provide ORS (95% confidence interval [CI] 12.3–16.9), 15.1% points less likely to provide ORT (95% CI 12.9–17.3), and 12.6% points more likely to provide other treatments (95% CI 10.4–14.8) than the public sector. Juxtaposing these results with the unadjusted difference in Table 3 shows that controlling for confounders reduced public–private disparities. The pharmacy indicator variable was the most instrumental in this decrease, indicating that pharmacies, which are almost exclusively private, provided particularly poor care. Moreover, within the private sector pharmacies were 13% points less likely than all other facility types to provide ORT ($P < 0.01$, results available from authors upon request).

Wealth and rural heterogeneity results. We found that poor children were less likely to receive ORT than wealthy children, but this effect was much stronger in the private sector (Table 5). For example, poor children in *private* facilities were 8% points less likely to receive ORT compared with wealthy children. In contrast, poor children in *public* facilities were only 3% points less likely to receive ORS compared with wealthy children. Thus, Table 5 shows that differences in ORT provision by wealth group were 4.9% points ($P < 0.01$) larger in the private sector compared with the public sector. Similarly, we found that poor children were more likely to receive other treatments (instead of ORT) compared with wealthy children; however, this effect was only present for children receiving care in the private sector (Table 5). In other words, we found no differences in rates of use of other treatments by wealth status in the public sector.

We found that children in rural areas that received care from private providers were less likely to receive ORS and ORT, and more likely to get other treatments relative to urban children (Table 6). For example, rural children that received care in the private sector were 6% points less likely to receive ORT. In contrast, there was little difference in treatment

between rural and urban children that received care in the public sector. Thus, the effect of going to a private provider compared with a public provider was 3.7%, 5.6%, and 7.4% points stronger (worse), for ORS ($P < 0.1$), ORT ($P < 0.01$), and other treatments ($P < 0.01$), respectively, in a rural area relative to an urban areas.

Full results from regression models presented in Tables 4–6 can be found in the Supplemental Appendix (Tables I–III).

Sensitivity analysis results. We found that all results from Tables 4–6 were stronger and more significant when using sampling weights (results not presented). The results of the propensity score matching sensitivity analysis were largely consistent with our main model results in Table 4 (see Table IV in the Supplemental Appendix). When assessing individual country public–private differences in treatment provision, we found that ORT provision rates were lower in the for-profit private sector in 28 out of 29 countries (see Figure 1). Table V in the Supplemental Appendix presents these results for all treatment categories. We also found that exclusion of any one country did not result in a dramatic change in our estimate of the public–private difference in treatment provision. Finally, we found relatively no change from the results in Table 4 when we restricted the analysis to children who sought treatment from a hospital or clinic.

DISCUSSION

Hundreds of thousands of children in SSA die every year from dehydration caused by diarrheal illness despite the availability of cheap and effective solutions. Many of these children seek care at private facilities. This study suggests that these two facts may be inextricably linked. The private sector performs worse than the public sector in treating childhood diarrheal in SSA and thus the proportion of children receiving care in private facilities is an important determinant of the burden of diarrheal illness. We found that children receiving care in private facilities were much less likely to receive ORS

TABLE 6
Probability of receiving treatment by rural/urban

	Oral rehydration salts (ORS)			Oral rehydration therapy (ORT)			Other treatment (no ORT)		
	Private	Public	Difference	Private	Public	Difference	Private	Public	Difference
Rural	50%	65%	-15.7%***+	54%	70%	-16.1%***+++	35%	20%	14.2%***+++
Urban	55%	67%	-12.0%***	60%	71%	-10.6%***	29%	22%	6.8%***

Probabilities are predicted from probit regressions that include rural by private interaction terms. Each regression controls for child age, child age squared, sex of child, child health, mother's age, mother's age squared, number of children in the household, if the mother was the head of the household, access to clean water, wealth, rural/urban, facility type, country-region, and year.

*** $P < 0.01$ = significance of the difference between public and private provision rates for rural and urban separately.

+++ $P < 0.01$, ++ $P < 0.05$, + $P < 0.1$ = significance of the difference in the public-private difference for rural areas relative to urban areas.

Bootstrap standard errors are estimated with 500 iterations and are clustered at the country level.

FIGURE 1. Differences in oral rehydration therapy (ORT) provision rate of private relative to public providers.

and ORT and much more likely to receive other treatments that are usually more expensive, less effective, and potentially harmful. Contrary to prior work, we mitigated doubts that these results may be driven by other factors because we controlled for key confounders.^{20–22} We found that controlling for confounders reduced estimates on the public–private discrepancy, but the adjusted effect of 15.1% points was still sizable and significant. Juxtaposing these results with the portion of children that received care in the private sector (24%) and the portion of children that were not treated with ORT in our sample (33.2%) implies that eliminating the public–private difference in ORT provision would decrease the portion of children not receiving ORT by 3.7% points ($0.24 \times 0.151 = 0.037$). This is an 11% reduction from a base of 33.2%. Assuming that diarrheal mortalities occur primarily among children not receiving ORT and reduce proportionally to changes in ORT provision, eliminating the public–private discrepancy in ORT provision would reduce diarrheal mortality among children that seek medical treatment by roughly 11%.

We also found that these public–private disparities in ORT provision and use of other treatments were worse for the most vulnerable children—that is, those who were poor and lived in rural areas. This may be because there is immense heterogeneity within the private sector²⁹ and low-quality private facilities may be cheaper and thus more likely to be visited by poor children and children in rural areas. For example, 41% of children from the poorest wealth group that visited a private provider visited a pharmacy—the least likely facility type to provide ORT—compared with only 27% of children in the richest wealth group. A study from Bangladesh displayed a similar pattern, finding that lower income children were more likely to seek treatment of diarrhea at unlicensed providers, and as a result, was less likely to receive ORT.³⁰ Another study from Lao found that facilities visited by poorer patients were less capable of providing diagnostics, examinations, or appropriate advice.³¹

Recently, the global health community has emphasized the role of the private sector in filling voids in health care where the public sector is inadequate. However, this study shows that enhancing private providers' role without effective engagement could have deleterious effects on treatment of child diarrhea. Unfortunately, recent findings from provider surveys in Kenya and Ghana show that engagement with the

private sector is limited.³² These findings are also echoed in a World Bank report, which collected data through expert stakeholder interviews in 45 countries in SSA.³³ Another study from Kenya suggests that under provision of cost-effective treatments by private providers is not limited to diarrheal treatment, but the private sector also performs worse in providing child immunization services.³⁴ Moreover, a recent systematic review comparing public–private differences on a range of outcomes suggests that the private sector more frequently violated medical standards and treatment guidelines, had worse diagnostic accuracy, and had poorer patient outcomes.³⁵ Overall, these studies suggest that if unregulated expansion of private health care continues in a way that crowds out or replaces the public sector, more children could be at risk of not receiving cost-effective treatments. To avoid this, it is essential that policy makers and multilateral organizations embrace a strategy of engagement with the private sector that nudges private health workers to increase provision of ORT and other cost-effective treatments. Strategies of engagement with the private sector in Kenya and Tanzania have shown to be effective at increasing child take-up of malaria medication.^{36,37} Similar strategies should be pursued for ORT.

Our findings are not without limitations. First, our results are based on self-report data, which could suffer from measurement error. Second, it is not completely clear what is driving the private sector to avoid providing ORT. Possible explanations for this finding include greater profit-seeking behavior, poorer provider knowledge of treatment guidelines, and less availability of ORS in the private sector. However, because of the limited nature of our data, we were unable to provide evidence of the mechanism driving public–private disparities in ORT provision. Future research should more fully investigate the extent to which the previous factors contribute to the underuse of ORT in the private sector through facility-based studies including physician and patient interviews. Third, we were unable to observe whether a child was dehydrated when treatment was sought. Although ORT is recommended for all children with diarrhea even if symptoms of dehydration are not present,⁹ health workers may be less inclined to follow this guideline if the child shows no signs of dehydration. If levels of dehydration differ between children that seek treatment at public and private providers, our results could be biased. Fourth, as in every observational study, one needs to be concerned about selection bias arising from confounding factors that affect both facility choice and ORS provision. We accounted for such selection bias by controlling for a variety of confounding factors including child and family characteristics, facility characteristics, and geographic characteristics. We also showed that the results are robust to alternate estimation methods such as propensity score matching, and limiting the analysis to children who attended hospitals or clinics. Nonetheless, it is still possible that unobserved differences between children who seek care at private facilities versus public facilities might be driving results. However, even if our results are confounded by unobservables and private ownership is not the *cause* of poor diarrheal care, it is still clear that private facilities do not appropriately treat child diarrhea and should be targeted for improvement.

Most countries in SSA are not on track to meet the Millennium Development Goal (MDG) of reducing child mortality

by two-thirds from 1990 to 2015. The results from this study suggest that improving diarrheal care in the private sector has the potential to reduce child mortality, which could push more countries toward achieving this elusive and important MDG.

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REFERENCES

- Walker CL, Rudan I, Liu L, Nair H, Theodoratou E, Bhutta ZA, O'Brien KL, Campbell H, Black RE, 2013. Global burden of childhood pneumonia and diarrhoea. *Lancet* 381: 1405–1416.
- Cash RA, Nalin DR, Rochat R, Reller LB, Haque ZA, Mizanur Rahman AS, 1970. A clinical trial of oral therapy in a rural cholera-treatment center. *Am J Trop Med Hyg* 19: 653–656.
- Pierce NF, Sack RB, Mitra RC, Banwell JG, Brigham KL, Fedson DS, Mondal A, 1969. Replacement of water and electrolyte losses in cholera by an oral glucose-electrolyte solution. *Ann Intern Med* 70: 1173–1181.
- Santosham M, 1982. Oral rehydration therapy of infantile diarrhea: a controlled study of well-nourished children hospitalized in the United States and Panama. *N Engl J Med* 306: 1070–1076.
- Spandorfer PR, Alessandrini EA, Joffe MD, Localio R, Shaw KN, 2005. Oral versus intravenous rehydration of moderately dehydrated children: a randomized, controlled trial. *Pediatrics* 115: 295–301.
- Munos MK, Walker CLF, Black RE, 2010. The effect of oral rehydration solution and recommended home fluids on diarrhoea mortality. *Int J Epidemiol* 39 (Suppl 1): i75–i87.
- Victora CG, Bryce J, Fontaine O, Monasch R, 2000. *Reducing deaths from diarrhoea through oral rehydration therapy*. Geneva: World Health Organization.
- Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C, Black RE, 2012. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet* 379: 2151–2161.
- USAID, 2005. *Diarrhea Treatment Guidelines: Including New Recommendations for the Use of ORS and Zinc Supplementation for Clinic-Based Healthcare Workers*. Arlington, VA: USAID Micronutrient Program.
- Forsberg BC, Petzold MG, Tomson G, Allebeck P, 2007. Diarrhea case management in low- and middle-income countries: an unfinished agenda. *Bull World Health Organ* 85: 42–48.
- Pantenburg B, Ochoa TJ, Ecker L, Ruiz J, 2012. Use of commercially available oral rehydration solutions in Lima, Peru. *Am J Trop Med Hyg* 86: 922–924.
- Ram PK, Choi M, Blum LS, Wamae AW, Mintz ED, Bartlett AV, 2008. Declines in case management of diarrhea among children less than five years old. *Bull World Health Organ* 86: E–F.
- Santosham M, Chandran A, Fitzwater S, Fischer-Walker C, Baqui AH, Black R, 2010. Progress and barriers for the control of diarrhoeal disease. *Lancet* 376: 63–67.
- Igun UA, 1994. Reported and actual prescription of oral rehydration therapy for childhood diarrhoeas by retail pharmacists in Nigeria. *Soc Sci Med* 39: 797–806.
- Tomson G, Sterky G, 1986. Self-prescribing by way of pharmacies in three Asian developing countries. *Lancet* 2: 620–622.
- Ickx P, 1996. *Central Asia Infectious Diseases Program, Simulated Purchase Survey, Rational Pharmaceutical Management, Kazakhstan*. Arlington, VA: BASICS.
- Howteerakul N, Higginbotham N, Freeman S, Dibley MJ, 2003. ORS is never enough: physician rationales for altering standard treatment guidelines when managing childhood diarrhoea in Thailand. *Soc Sci Medicine* 57: 1031–1044.
- Baqui AH, Black RE, El Arifeen S, Yunus M, Zaman K, Begum N, Roess AA, Santosham M, 2004. Zinc therapy for diarrhoea increased the use of oral rehydration therapy and reduced the use of antibiotics in Bangladeshi children. *J Health Popul Nutr* 22: 440–442.
- Aung T, McFarland W, Khin HS, Montagu D, 2012. Incidence of pediatric diarrhea and public-private preferences for treatment in rural Myanmar: a randomized cluster survey. *J Trop Pediatr* 59: 10–16.
- Muhuri PK, Anker M, Bryce J, 1996. Treatment patterns for childhood diarrhoea: evidence from demographic and health surveys. *Bull World Health Organ* 74: 135.
- Langsten R, Hill K, 1995. Treatment of childhood diarrhea in rural Egypt. *Soc Sci Med* 40: 989–1001.
- Waters HR, Hatt LE, Black RE, 2008. The role of private providers in treating child diarrhoea in Latin America. *Health Econ* 17: 21–29.
- Database of Medicine Prices, Availability, Affordability and Price Components, 2008. Available at: <http://www.haiweb.org/MedPriceDatabase/>. Accessed September 20, 2013.
- IFC, 2011. *Healthy Partnerships: How Governments Can Engage the Private Sector to Improve Health in Africa*. Washington, DC: World Bank Publications.
- Berendes S, Heywood P, Oliver S, Garner P, 2011. Quality of private and public ambulatory health care in low and middle income countries: systematic review of comparative studies. *PLoS Med* 8: e1000433.
- WHO, UNICEF, 2009. *Diarrhoea: Why children are still dying and what can be done*. Geneva: UNICEF/WHO.
- Rutstein SO, Johnson K, 2004. *The DHS Wealth Index*. Calverton, MD: Demographic and Health Surveys.
- Rutstein SO, Rojas G, 2006. *Guide to DHS Statistics*. Calverton, MD: Demographic and Health Surveys.
- Waters H, Hatt L, Peters D, 2003. Working with the private sector for child health. *Health Policy Plan* 18: 127–137.
- Larson CP, Saha UR, Islam R, Roy N, 2006. Childhood diarrhoea management practices in Bangladesh: private sector dominance and continued inequities in care. *Int J Epidemiol* 35: 1430–1439.
- Paphassarang C, Philavong K, Boupha B, Blas E, 2002. Equity, privatization and cost recovery in urban health care: the case of Lao PDR. *Health Policy Plan* 17 (Suppl 1): 72–84.
- Sood N, Burger N, Yoong J, Kopf D, Spreng C, 2011. Firm-level perspectives on public sector engagement with private healthcare providers: survey evidence from Ghana and Kenya. *PLoS ONE* 6: e27194.
- Staff World Bank, 2011. *Healthy Partnerships: how governments can engage the private sector to improve health in Africa*. Washington, DC: World Bank Publications.
- Sood N, Wagner Z, 2012. For-profit sector immunization service provision: does low provision create a barrier to take-up? *Health Policy Plan* 28: 730–738.
- Basu S, Andrews J, Kishore S, Panjabi R, Stuckler D, 2012. Comparative performance of private and public healthcare systems in low- and middle-income countries: a systematic review. *PLoS Med* 9: e1001244.
- Kangwana BP, Kedenge SV, Noor AM, Alegana VA, Nyandigisi AJ, Pandit J, Fegan GW, Todd JE, Brooker S, Snow RW, 2011. The impact of retail-sector delivery of artemether-lumefantrine on malaria treatment of children under five in Kenya: a cluster randomized controlled trial. *PLoS Med* 8: e1000437.
- Sabot OJ, Mwita A, Cohen JM, Ipuge Y, Gordon M, Bishop D, Odhiambo M, Ward L, Goodman C, 2009. Piloting the global subsidy: the impact of subsidized artemisinin-based combination therapies distributed through private drug shops in rural Tanzania. *PLoS ONE* 4: e6857.