

Can mobile phone messages to drug sellers improve treatment of childhood diarrhoea?—A randomized controlled trial in Ghana

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Oral rehydration solution (ORS) and zinc are the recommended treatment in developing countries for the management of uncomplicated diarrhoea in children under five (World Health Organization and UNICEF 2004). However, drug sellers often recommend costly and unnecessary treatments instead. This article reports findings from an experiment to encourage licensed chemical sellers (LCS) in Ghana to recommend ORS and zinc for the management of childhood diarrhoea. The intervention consisted of mobile phone text messages (Short Message Service or SMS) sent to a randomly assigned group of LCS who had been trained on the diarrhoea management protocols recommended by the World Health Organization (WHO). The SMS campaign comprised informational messages and interactive quizzes sent over an 8-week period. The study measured the impact of the SMS messages on both reported and actual practices. Analysis of data from both face-to-face interviews and mystery client visits shows that the SMS intervention improved providers' self-reported practices but not their actual practices. The study also finds that actual practices deviate substantially from reported practices.

Keywords Antibiotics, child health, diarrhoea, Ghana, mobile phones, oral rehydration solution, pharmaceutical sellers, SMS, zinc

KEY MESSAGES

- SMS mobile phone text messages had a positive impact on providers' reported practices.
- SMS mobile phone text messages did not have a detectable impact on providers' actual practices.
- There are differences between providers' reported practices and actual practices.
- Perceived consumer demands and profit motives may explain differences between reported and actual practices.

Introduction

Diarrhoea is one of the leading causes of death among children in developing countries (Black *et al.* 2010). Most of these deaths are related to dehydration, which can be prevented through the use of low-cost treatments such as Oral Rehydration Salts

(-ORS). In May 2004, after determining that paediatric zinc supplementation yields dramatic reductions in diarrhoeal death and can reduce future episodes of diarrhoea, the World Health Organization (WHO) and the United Nations Children's Fund

(UNICEF) issued a joint statement endorsing the use of zinc in addition to ORS as the first-line treatment for uncomplicated diarrhoea in children under age five (WHO and UNICEF 2004). Despite their life-saving potential, health providers sometimes do not recommend ORS and zinc and provide anti-microbials and anti-diarrhoeals instead (WHO 2005).¹ Thus, suboptimal treatment of paediatric diarrhoea remains a major public health problem in developing countries.

Private for-profit providers are an important source of treatment for paediatric diarrhoea in developing countries. However, one recent study using Demographic and Health Surveys data from 29 sub-Saharan African countries found that for-profit providers are less likely than public sector providers to provide ORS and more likely to provide other treatments. Initiatives to improve private provider practices may require different approaches from those used in the public sector. Private providers may be more influenced by factors such as profit motivations, lack of familiarity with treatment guidelines and limited availability of ORS in the private sector (Sood and Wagner 2014).

This article reports the results of an experiment to test the effectiveness of an intervention to encourage Licensed Chemical Sellers (LCS), which are private sector drug sellers in Ghana, to recommend ORS and zinc for uncomplicated childhood diarrhoea and avoid providing anti-microbials and anti-diarrhoeals. This intervention and the accompanying evaluation were implemented by the Strengthening Health Outcomes through the Private Sector (SHOPS) project in partnership with a third-party evaluator (the first author) with funding from the United States Agency for International Development (USAID). The intervention used interactive mobile phone text messages (Short Message Services) and quizzes with airtime prizes, sent to LCS and their shop assistants² to reinforce sensitization training related to appropriate management of childhood diarrhoea.

Many health initiatives are using SMS as an approach for interacting with health providers in low-income countries due to its low cost and the rapid increase in mobile phone ownership and service availability. The SHOPS project hypothesized that SMS may also be a useful mechanism for interacting with private sector providers who cannot afford to take substantial time away from their facilities to attend trainings. However, there is limited rigorous evidence of the impact of SMS-based healthcare interventions in low-income settings (Free *et al.* 2013). This experiment examines the impact of this SMS intervention on both provider knowledge, as measured by their reported practices³ and their actual practices. A face-to-face provider survey of LCS measured reported practices, while a mystery client survey assessed actual practices.

The study finds that although the text messages increased the proportion of drug sellers who reported ORS and zinc as their most common recommendation for paediatric diarrhoea, this increase did not lead to a change in the providers' actual practices. This research also showed that providers' reported practices often deviated from their actual practices. Additional data collected in the study suggest that external factors, such as perceived consumer demand or profit motives, may explain why there was a difference. This article contributes to the understanding of the potential of SMS as a low-cost intervention to

affect health providers' treatment practices in developing countries.

Prior research

Several studies have examined interventions targeted at improving provider knowledge and behaviour related to treatment of diarrhoea. The findings of these studies have been mixed. One study found that a face-to-face educational outreach programme, intended to encourage providers in Kenya and Indonesia to provide ORS in place of anti-microbials, increased providers' knowledge and (self) reported provision of ORS (Ross-Degnan *et al.* 1996). Another study that compared small-group and large-group interventions targeted at providers in Indonesia, designed to increase the prescription of ORS in place of anti-microbials, found that small-group interventions are more effective at increasing knowledge than large-group interventions. However, the study also found that these small-group interventions are more expensive and less cost effective (Santoso 1996). A study of a diarrhoea management campaign in Bangladesh noted that, while awareness of newly introduced zinc treatments could be achieved rapidly through educating providers and informing caregivers about zinc, changing provider and caregiver behaviours to encourage the use of zinc was more difficult and may require further, behaviour-focused interventions (Larson *et al.* 2012).

There have been few studies of the impact of SMS on provider behaviour.⁴ One recent study in Kenya demonstrated that one-way (non-interactive) text messages sent twice daily to health workers for 6 months increased adherence to recommended malaria treatment practices (Zurovac *et al.* 2011). However, a meta-analysis of SMS interventions to improve service delivery highlighted the general lack of adequately powered trials in low-income settings (Free *et al.* 2013).

Prior research demonstrates a gap between what providers know and their actual practices (Ofori-Adjei and Arhinful 1996; Paredes *et al.* 1996; Rowe *et al.* 2000, 2005; Leonard *et al.* 2007; Mæstad and Torsvik 2008; Leonard and Masatu 2010a). Some of these studies rely on vignettes to ask providers how they would treat patients in hypothetical scenarios, as described by Das and Hammer (2005). The providers' self-reported behaviour is interpreted as a measure of provider knowledge, and direct observation as a measure of actual practices (Das *et al.* 2008). These studies then demonstrate that external factors can widen or shrink the gap between knowledge of what should be done and what is done in practice (Das and Hammer 2007; Das *et al.* 2008; Leonard and Masatu 2010b; Currie *et al.* 2011). Das and Hammer (2007) find that private sector doctors in India are very responsive to patients' expectations, even if this means deviating from doing what they know they should do. Currie *et al.* (2011) find that doctors in China are less likely to provide antibiotics if a mystery client demonstrates knowledge of appropriate antibiotic use than if the mystery client does not do so. The authors hypothesize that doctors are providing antibiotics unnecessarily due to profit motives or other reasons. Thus, prior research suggests that reported practices are not always an accurate proxy for actual practices.

This study builds upon existing research on interventions to improve provider treatment behaviour by examining the impact

of SMS on improving adherence to WHO standards for treatment of paediatric diarrhoea. This study also explores the differences in reported and actual practices by healthcare providers.

Methods

Context

To promote appropriate treatment of childhood diarrhoea, the SHOPS project, in collaboration with the Ghana Pharmacy Council, which licenses and oversees LCS, held a series of 3-hour trainings for LCS in 26 districts in the Greater Accra, Central and Western regions, in May of 2012.⁵ These trainings, advertised through newspapers, were required as part of the Pharmacy Council's Continuing Medical Education⁶ programme, and participants were charged approximately US\$5 (10 Ghana cedi/GHS). Representatives of 1935⁷ LCS shops attended the trainings, which provided information about assessment of diarrhoea, recommended ORS and zinc, specified the limited use of anti-microbials (only for diarrhoea with blood in the stool), and explained the dangers of anti-diarrhoeal drugs for children.

The trainers provided all LCS who attended the training with information on how and where to purchase zinc, which was available at nationwide wholesale distributor networks beginning in January 2012, in addition to general information about diarrhoea.⁸ Thus, all training participants are assumed to have adequate access to ORS and zinc, should they choose to keep it in stock.

In Ghana, SHOPS worked closely with its local pharmaceutical manufacturing partner, M&G Pharmaceuticals, Ltd, to introduce and market their Zintab product to private sector clinics, pharmacies and LCS. Partnership activities included printing and disseminating branded point of sale and detailing materials, sponsoring clinical meetings and airing branded radio advertisements. M&G sponsored numerous continuing medical education sessions for clinical providers and marketed their zinc products during the training of LCS and during detailing/sales visits to retailers. These activities were supported by follow-up detailing visits, conducted by M&G medical representatives, who were trained by the SHOPS project to provide appropriate interpersonal communications on diarrhoea management.

In July 2012, SHOPS launched a nationwide mass media campaign that included television and radio advertisements, conducted community mobilization activities and detailing visits through partner Non-Governmental Organizations (NGOs), and developed and disseminated informational posters to health care providers. The campaign continued for 6 months and was designed to increase awareness of the new diarrhoea treatment protocols for children under five. The campaign provided information on the effectiveness of ORS and zinc for treating diarrhoea, how to correctly administer both products, and where consumers could obtain the products. See Figure 1 for a timeline.

Study design and SMS intervention

The SHOPS project offered all attendees of the training sessions the option to sign up for the SMS study by sending an SMS text message from their mobile phones to a specified number with the message 'SHOPS'. Staff members informed attendees

that sending and receiving messages would be at their own expense, and that not everyone who opted into the study would receive the SMS messages. Out of the 1935 LCS facilities, a total of 910 had at least one employee who opted into the SMS study. These 910 LCS facilities were randomly assigned using a random number generator in Stata after the trainings, to receive the SMS messages or not, stratifying by district. Thus, 455 shops were assigned to the intervention group and 455 shops were assigned to the control group.⁹

The delivery of SMS messages commenced on 7 June 2012, immediately following the end of the sensitization trainings. The SMS messages were sent on every Monday, Wednesday and Thursday for 8 weeks, until 2 August 2012. These messages focused on encouraging the recommendation of ORS and zinc and discouraging the use of anti-microbials and anti-diarrhoeals. The messages also covered symptoms of dehydration. Table 1 shows examples of the messages. The SMS campaign format consisted of one quiz¹⁰ per week (true/false and multiple choice) as well as two tips per week. Recipients could use their phones to respond to the quizzes, and if they answered at least one quiz correctly they were sent a one-time prize of approximately US\$0.52 (1 GHS).

Sample

Representatives from 1935 LCS shops attended the original training, and of these attendees, 910 agreed to participate. Data collection commenced in August 2012 following the end of the SMS intervention. The sample of surveyed facilities consisted of 699 facilities with complete data, including 354 facilities in the intervention group and 345 in the control group, which represents 76.8% of the full experimental sample. Of the original 910 facilities that opted into the study, there were 190 facilities that could not be located by the data collection firm (including 90 from the intervention group and 100 from the control group) and 21 other facilities (including 11 from the intervention group and 10 from the control group) in which the data collection firm conducted a mystery client survey but not a provider interview and were excluded from analysis, as shown in Figure 2. The overall attrition rate was 23.2% (22.2% in intervention shops and 24.1% in control shops). The difference in the attrition rates between intervention and control groups was 2.1% for both the provider and mystery client surveys, and this difference is not statistically significant.¹¹

As shown in Table 2, there was only one statistically significant difference that appears between the characteristics of the intervention and control groups. This difference is in urban-rural status, with 7% fewer facilities of the intervention group located in urban settings, and this is significant at the 10% level. There is no indication that the analysis sample is skewed differentially between the intervention and control groups to introduce bias into the impact estimates.

Data and measures

This article uses two data sources: mystery client surveys and provider surveys, conducted in person at each facility from August 2012 to early January 2013. The primary outcomes of interest were reported practices, as measured by the provider survey, and actual practices, as measured by the mystery client survey. To initiate the data collection process, the interviewers

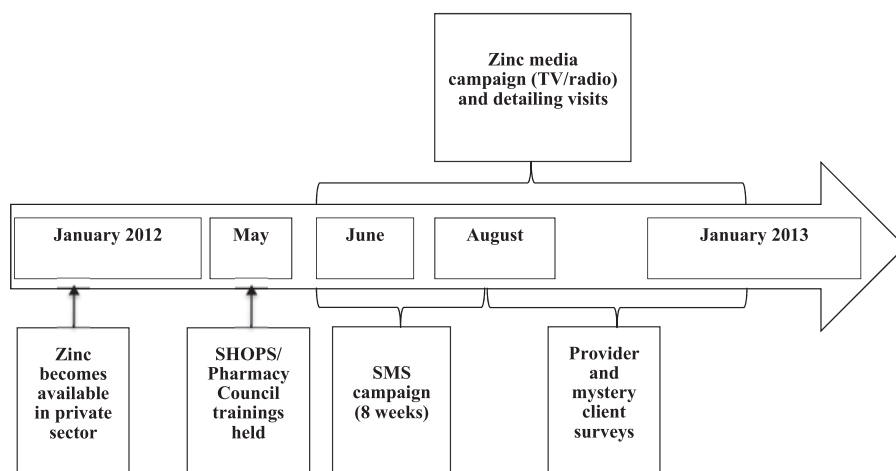


Figure 1 Timeline of intervention and evaluation activities

Table 1 Examples of the SMS messages sent between June and August 2012 to LCS in Greater Accra, Central and Western regions, Ghana

Informational tip/quiz	Automatic reply (for quizzes) sent by SMS system
<p>Tip: When a caregiver asks for antibiotics, ask if there is blood in stool. Bloody stool is a sign of dysentery and the child should be referred to a health clinic.</p> <p>Tip: Remember, it is important to counsel caregivers on how to prepare ORS properly.</p> <p>Quiz: Which of following is NOT a benefit of zinc?</p> <p>A. Protects against future episodes B. Stops diarrhoea faster C. Treats dehydration</p> <p>Reply 'SHOPS' then A, B, or C</p> <p>Quiz: Zinc is only a supplement and <u>not</u> an effective treatment for childhood diarrhoea. True or False? Reply SHOPS T if true or SHOPS F if false.</p>	<p>(If SHOPS C): CORRECT! Zinc protects against diarrhoea, lessens severity and stops diarrhoea faster, but does not treat dehydration.</p> <p>(If SHOPS A or B): Sorry, that is not correct, zinc does not treat dehydration, which is why it must be taken with ORS. Please check your manual.</p> <p>(If SHOPS T): Wrong answer! Zinc is not just a supplement. It is nationally recommended for treatment of childhood diarrhoea in Ghana.</p> <p>(If SHOPS F): Very good! Zinc reduces seriousness and stops childhood diarrhoea faster. It also prevents future episodes.</p>

Note: The 'SHOPS' prefix had to be used in responses in order for the SMS system to route the messages correctly.

from the research firm called the facility and asked for providers' consent to be interviewed. During the phone call, the interviewer explained that the Ghana Pharmacy Council had approved the study, and made appointments for the provider interview. The interviewers conducted the mystery client visit at least one day before the scheduled provider interview, to prevent the provider interview from influencing LCS behaviour towards the mystery client.

For both the provider and mystery client surveys, the enumerators interviewed the first available provider, whether the LCS or a shop assistant, since that person would be the one typically attending the clients. The authors felt that this approach would provide a better estimate of the policy-relevant impact—that is, a change in behaviour on the part of the person who typically responds to clients. However, it is possible that the person interviewed may not be the same individual who attended training and/or received the SMS messages.

Mystery client surveys

The objective of the mystery client survey was to assess provider practices. For these surveys, a female interviewer visited each provider, posing as a client with a child who was at home and suffering from uncomplicated diarrhoea. The mystery clients were recruited by the local data collection firm from the same regions in which they were assigned to collect data. The mystery clients were instructed to wear clothing that was appropriate for the area in which they were operating, and which would make them appear neither wealthy nor poor, and to speak the language that would typically be used when a person from the local area interacts with an LCS.¹² The interviewers communicated only basic symptoms of a child with diarrhoea. If the provider asked, the mystery clients were trained to give a standard set of details about the age, weight and symptoms of the child, which were designed to simulate a child experiencing uncomplicated diarrhoea—frequent watery

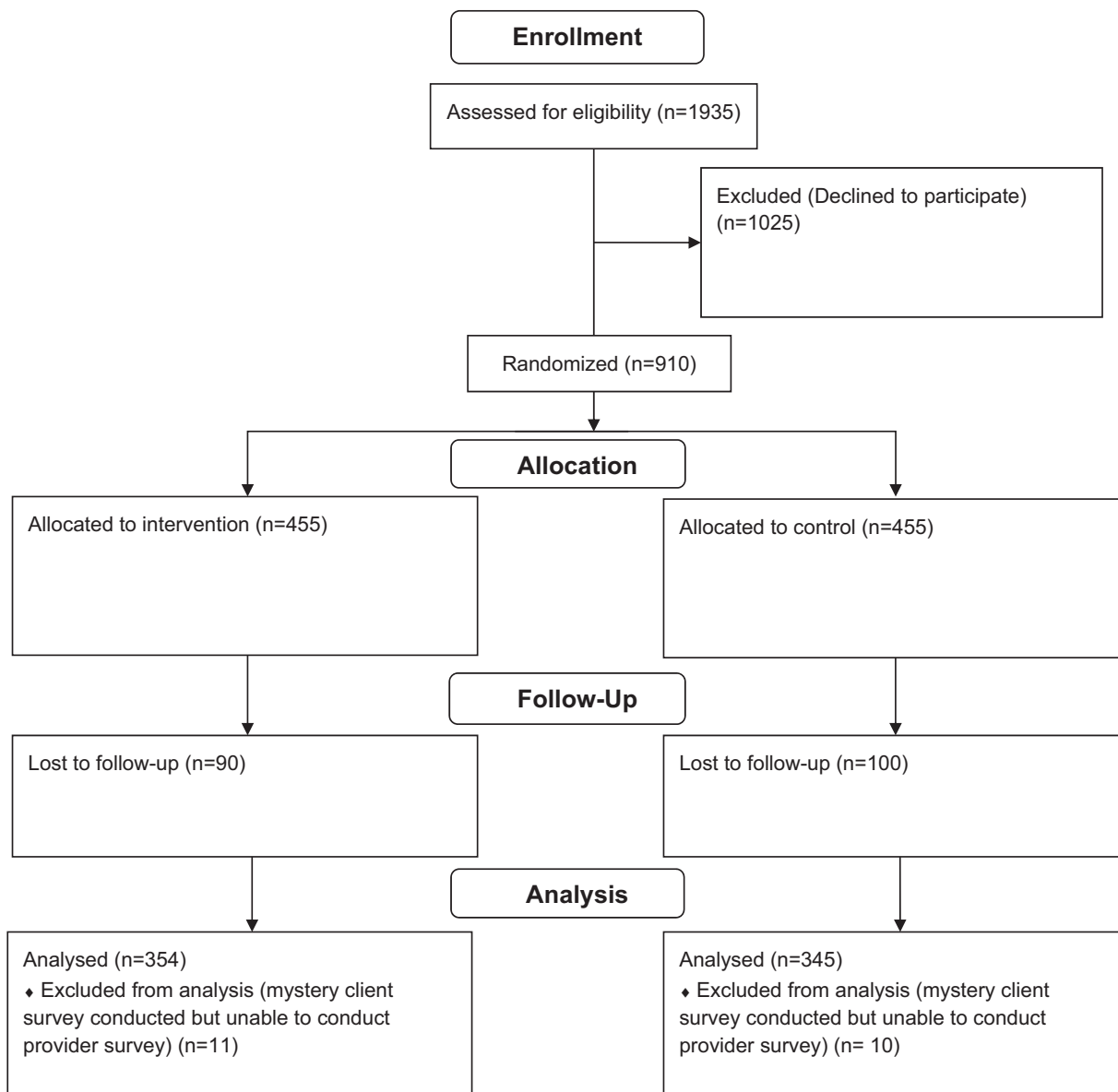


Figure 2 Consolidated Standards of Reporting Trials (CONSORT) flow diagram

stools but without bloody stools or fever. The mystery clients continued to engage with the provider until they received advice or a product. The mystery clients purchased whichever products were recommended by the provider, up to a maximum of 10 GHS (approximately US\$5). After leaving the LCS facility, the mystery client would document the provider's actions, such as diagnostic questioning, the products purchased and the prices of those products. The primary outcome measures of interest for the mystery client survey were whether or not the LCS provided ORS, zinc, anti-microbials and/or anti-diarrhoeals, referred to as the actual practices of the provider in this study.

Ethical considerations regarding the use of mystery clients

The use of mystery clients has been widely used in studies that aim to measure health service provider behaviour (Madden *et al.* 1997). Still, the ethics surrounding the deception involved

in their use can raise concerns. This study used a mystery client methodology similar to that used in previous studies in similar contexts (e.g. Currie *et al.* 2011; Lu 2014). All LCS in the initial training sessions, where attendees were invited to participate in the study, were informed that mystery clients might visit their shops. In preparation for the surveys, all LCS included in the study were contacted by the local data collection firm and asked if they were willing to be interviewed, following a consent script approved by the Ghana Health Service Ethical Review Committee. Only facilities that gave informed consent are included in the study.

Consent was not requested specifically for the mystery clients when shops were called. This decision was taken to prevent biasing behaviour, as it has been demonstrated that knowing one is being watched can change behaviour (referred to as the Hawthorne effect). This has been specifically demonstrated with

Table 2 Characteristics of the analysis sample of LCS in Greater Accra, Central and Western regions, Ghana

	Intervention mean (Standard Deviation)	Control mean (Standard Deviation)	Difference (Standard Error)
Age (years)	39.49 (15.79)	39.69 (15.26)	-0.19 (1.19)
Male	0.603 (0.490)	0.593 (0.492)	0.010 (0.037)
Post-secondary education	0.760 (0.428)	0.765 (0.425)	-0.005 (0.032)
Years of LCS experience	9.440 (8.527)	8.775 (7.680)	0.665 (0.616)
LCS interviewed (vs assistants)	0.529 (0.500)	0.50 (0.501)	0.029 (0.038)
Respondent attended training	0.650 (0.448)	0.684 (0.466)	-0.034 (0.036)
<i>Geographic location (three regions total)</i>			
Central Region	0.247 (0.432)	0.253 (0.435)	-0.006 (0.028)
Greater Accra	0.266 (0.442)	0.267 (0.444)	-0.002 (0.029)
Western Region	0.487 (0.50)	0.478 (0.50)	0.009 (0.032)
Urban	0.503 (0.501)	0.565 (0.495)	-0.062* (0.038)
Total observations (<i>n</i>)	354	340	694

All variables are indicators, unless otherwise noted.

*Statistically significant at the $P \leq 0.10$ level.

**Statistically significant at the $P \leq 0.05$ level.

***Statistically significant at the $P \leq 0.01$ level.

health care workers (e.g. Leonard and Masatu 2010a). Human subjects' rules allow for the waiving of informed consent when obtaining consent would threaten the study, when participants are participating in standard activities, and when there is not a threat of harm to participants. All of these are true in this study. Human subjects' rules further stipulate that uninformed participants should be debriefed, unless justified because doing so would cause additional harm.¹³ In this case, the participants had been told to expect mystery clients, and we feared that immediately debriefing would threaten the reliability of further data collection, which was ongoing. However, SHOPS and the Pharmacy Council held debriefings and presented the results of the study at subsequent rounds of LCS trainings beginning in July of 2014, held at districts throughout Ghana.

The study was reviewed and approved by the Ghana Health Service Ethical Review Committee and the Abt Associates Inc. Institutional Review Board.

Provider surveys

In the face-to-face provider survey, which was conducted in English, the interviewer recorded reported practices from the LCS, to estimate the impact of the SMS intervention on knowing appropriate diarrhoea management practices and to shed light on their decision-making process. A signature of informed consent was obtained from all respondents before the survey began. The provider survey documented reported practices in two ways. The first was a direct, closed-ended question, 'Do you currently recommend X for children under five with diarrhoea?' This question was asked for anti-microbials, anti-diarrhoeals, ORS and zinc, with the names of commonly used products given with each category in case the respondent was uncertain about the category in which a given product belonged. Next, to document providers' reported practices without prompting, the questionnaire included an open ended question asking respondents which product they recommend most often and second most often for diarrhoea in children under 5 years of age. Thus, the key outcomes measured in the

provider survey were whether or not ORS, zinc, anti-microbials and/or anti-diarrhoeals were mentioned as most often prescribed or second most often prescribed.

Providers were also asked programmatic questions aimed at informing programme interventions, such as whether they had zinc in stock, whether they knew where to obtain zinc tablets, and whether they felt the pricing of zinc was appropriate. The interviewers also asked LCS about whether their clients have ever refused ORS or zinc and what treatments their clients prefer in order to measure perceived consumer demands.

Threats to internal and external validity

Standard concerns with observational studies, in which the internal validity is threatened by selection or omitted variables are likely to have limited scope in the internal validity of this study because of the balance between intervention and control groups from the randomized design. Still, other biases can threaten experiments, and we believe that many of these threats are minimized in our study. Both groups were interviewed at similar time periods, so any limited recall would be expected to be similar across groups. In addition, the surveys asked about and observed recent behaviour. Volunteer bias is unlikely to detract from the internal validity as both the intervention and control groups were selected from LCS who opted in. If receiving the SMS made LCS more or less likely to agree to be interviewed, then this could be a possible source of volunteer bias. However, the rate of refusals was less than 1%, so this is unlikely to introduce substantial bias. It is possible that those who were interviewed were not always the same individuals receiving the SMS, as indicated in Table 2. Thus, any limits may not reflect the impact on the individual provider, but rather the net impact of the intervention on what a shop provides to a representative client. The providers' self-reported behaviour may not always reflect their actual practices. In general, self-reports—particularly of pro-social behaviour—may not be entirely reliable. The use of mystery clients provides

an additional level of credibility in the measurement of behaviour.

Regarding generalizability, the reasons for non-response across both experimental groups suggest that the analysis sample is likely to be less isolated than the full experimental sample, in terms of geography and access to communication. Specifically, the analysis sample is more likely to contain facilities operated by LCS who have their phone in operation, and facilities located in more accessible areas, or areas with more reliable phone service. Thus, the impacts estimated for the analysis sample might be larger than would be the case for the overall sample, because the intervention was based on mobile phones. Also, given that only LCS who opted voluntarily to receive the SMS campaign was included in the study, we cannot generalize results to LCS who did not wish to receive the messages.

Analysis

The impact of the programme on reported and actual practices was estimated as the difference in the means between the control and intervention groups. We run a *t*-test of the significance of this difference, which is equivalent to regressing the outcome on a binary indicator for being part of the intervention, or estimating the following equation:

$$Y_j = \beta_0 + \beta_1 \text{SMS}_j + \varepsilon_j$$

Y_j represents the outcome of interest for facility j , SMS_j is a binary indicator representing assigned intervention status and β_1 is the coefficient of interest. This coefficient is equivalent to the difference between the mean of Y_j in the intervention group and the mean of Y_j in the control group.

Randomization ensures that the intervention status is exogenous with respect to observable and unobservable characteristics of the individuals involved, which removes the need to include variables to control for observable characteristics. In addition to the main specification, we estimated the effects of the intervention including controls for age, experience, education, sex, an indicator for being the facility owner, urban–rural status and the survey date. These estimates produced results that are similar in terms of magnitude and statistical significance. While including control variables can increase the precision of the estimates in the analysis of an experiment, our sample in this specification was reduced (19 fewer observations with complete data), and therefore, their inclusion did not reduce the size of our standard errors (increase precision).

We also compare reported vs actual treatment recommendations. Here we examine the means (combining the intervention and control groups) of reported practices from the provider survey next to observed practices from the mystery client survey. This comparison investigates whether respondents report practices that adhere more closely to WHO guidelines than their actual, observed behaviour. Respondents were asked about their paediatric diarrhoea treatment practices using two different sets of questions: open-ended questions about the two treatments that they most commonly recommend and closed-ended questions about whether they currently recommend each type of treatment. To be conservative with this comparison, we compare the response to the question that is more likely to give an answer that is farther from the WHO recommended practice.

For anti-microbials and anti-diarrhoeals, this is the closed-ended question (Do you currently recommend X treatments for children under 5 with diarrhoea?), which yielded a higher estimate of its use than the open-ended question. For ORS and zinc, we use responses to the open-ended question (Of the medicines and products that you keep in stock for diarrhoea, what is the treatment that you recommend most often¹⁴ for diarrhoea in children under five?) of prescription behaviour (measured as listing ORS and zinc among these two treatments), which gives a lower estimate than the closed-ended question.¹⁵ These choices should make it less likely that we would find that self-reported behaviour is closer to WHO recommended practices than is observed behaviour.

Results

Actual practices

Results from the impact analysis of the intervention on actual practices of the LCS, as measured by the mystery client survey, are shown in Table 3. Although the intervention LCS were slightly more likely to recommend ORS and zinc, they were also slightly more likely to recommend anti-microbials and anti-diarrhoeals. None of these differences are large or statistically significant. Results controlling for a vector of covariates (not reported) are generally similar across specifications in terms of direction and magnitude of the effect and the statistical significance.

Self-reported practices

Self-reported practices were analysed for the first and second most-recommended products for management of childhood diarrhoea, as shown in Table 4. Here there is a small difference in reported recommendation of ORS and zinc that is not statistically significant. However, there is a larger and statistically significant difference between the intervention and control groups in the reported use of both anti-microbials and ‘ideal recommendation’ (ORS and zinc, with no anti-microbials or anti-diarrhoeals).

Comparison of actual practices and self-reported practices

There is a substantial gap between actual practices (as measured by the mystery client) and reported practices (as stated in the provider survey). For example, while 88.6% of the control group reported that they recommend ORS most or second most, only 78.5% actually provided it to the mystery client. The difference between reported and actual practices is larger for anti-microbials: only 9.7% of LCS in the control group reported recommending anti-microbials when asked directly (closed-ended) whether they currently recommend them for paediatric diarrhoea in general, but 47.8% provided it to a mystery client whose purported child had symptoms of uncomplicated diarrhoea, which does not require anti-microbials (Table 5).

Table 3 Products recommended to mystery clients: comparison of intervention and control licensed chemical sellers

Actual recommendation by LCS	Intervention mean (SD)	Control mean (SD)	Difference coeff. (SE)
Recommended ORS	0.807 (0.394)	0.785 (0.411)	0.021 (0.030)
Recommended zinc	0.657 (0.475)	0.660 (0.474)	-0.003 (0.035)
Recommended ORS and zinc	0.628 (0.483)	0.643 (0.479)	-0.014 (0.036)
Recommended ORS or Zinc (or both)	0.833 (0.373)	0.802 (0.398)	0.030 (0.029)
Recommended anti-microbials	0.461 (0.499)	0.495 (0.500)	-0.033 (0.037)
Recommended anti-diarrhoeals	0.121 (0.327)	0.104 (0.306)	0.017 (0.024)
Total observations (<i>n</i>)	345	353	698

All variables are indicators.

*Statistically significant at the $P \leq 0.10$ level.

**Statistically significant at the $P \leq 0.05$ level.

***Statistically significant at the $P \leq 0.01$ level.

Table 4 Self-reported recommendation by LCS in Ghana's Greater Accra, Central and Western regions of treatments for childhood diarrhoea, comparison between intervention and control groups

Reported recommendation by LCS	Intervention mean (SD)	Control mean (SD)	Difference coeff. (SE)
ORS: first or second most frequent	0.903 (0.295)	0.886 (0.317)	0.016 (0.023)
Zinc: first or second most frequent	0.807 (0.394)	0.765 (0.424)	0.042 (0.030)
Anti-microbials: first most frequent	0.059 (0.236)	0.115 (0.320)	-0.056* (0.021)
Anti-diarrhoeals: first most frequent	0.008 (0.091)	0.023 (0.150)	-0.014 (0.009)
Ideal reported practices: (ORS and zinc most frequent; no anti-microbials or anti-diarrhoeals)	0.774 (0.418)	0.707 (0.455)	0.066** (0.033)
Total observations (<i>n</i>)	345	354	699

Note: Because some LCS responded that they provide ORS and zinc together as their first most frequent recommendation, they may have felt obliged to state anti-microbials or anti-diarrhoeals as their second most frequent recommendation. Thus, for conservatism, citing anti-microbials or anti-diarrhoeals is only considered as a negative outcome if given as the first most frequent recommendation. All variables are indicators.

*Statistically significant at the $P \leq 0.10$ level.

**Statistically significant at the $P \leq 0.05$ level.

***Statistically significant at the $P \leq 0.01$ level.

Discussion

This SMS programme improved *reported practices* related to recommendation of WHO-recommended products for management of childhood diarrhoea, but it did not significantly change *actual practices* among LCS. Still, overall levels of recommendation of ORS and zinc are high among both the intervention and control groups. Two-thirds recommended zinc and four-fifths recommended ORS. Nearly all of those LCS who provided zinc also provided ORS, which is a desirable outcome given that zinc is recommended as a complementary product for ORS and not a substitute. Zinc had been on the market for less than a year and there was almost no awareness of the product among LCS prior to January 2012. This finding suggests that the other non-SMS interventions (training, mass media campaign and detailing visits) were quite effective at increasing zinc provision by LCS. However, the high rates of ORS and zinc provision in both

control and intervention groups left less room for improvement and may have made it more difficult to detect an impact from the SMS campaign.

Several possible explanations exist for why the SMS intervention may not have improved actual practices, even if reported practices changed. First, it may be that the providers do not believe the information they have been given. In that case, an intervention will be ineffective in changing practices if it merely provides information that providers do not necessarily believe. This explanation could be consistent with providers repeating the answers the trainings supported, when asked for them explicitly. A qualitative analysis of provider beliefs might elicit a more nuanced understanding of what drives provider decisions.

Second, providers may respond to real or perceived consumer demand. If consumers want a specific product, then a private sector provider such as an LCS may feel compelled to provide

Table 5 Self-reported practices (provider survey) compared to actual recommendations (mystery client) of products for childhood diarrhoea, among by LCS in Ghana's Greater Accra, Central and Western regions, August 2012–January 2013 (intervention and control groups combined)

Treatment type	Mean, intervention and control groups (SD)
'Do you currently recommend anti-microbial treatments (Flagyl, Cipro, Septrin, or others) for children under 5 with diarrhoea?'	0.097 (0.319)
Actual recommendation of anti-microbials	0.478 (0.499)
'Do you currently recommend anti-diarrhoeal treatments or products (such as Imodium and Kaolin) for children under 5 with diarrhoea?'	0.082 (0.300)
Actual recommendation of anti-diarrhoeals	0.113 (0.317)
ORS , reported (first or second most frequent)	0.895 (0.306)
Actual recommendation of ORS	0.796 (0.402)
Zinc , reported (first or second most frequent)	0.786 (0.409)
Actual recommendation of zinc	0.659 (0.474)
Total observations (<i>n</i>)	699

All variables are indicators.

customers with what they want, regardless of whether the requested product is the most appropriate choice. In the provider survey, 25% of our respondents report that some caregivers refused ORS; similarly, 12% of those who had recommended zinc report that some caregivers refused to purchase it. However, in the mystery client survey, the client did not ask for any particular product, so the LCS was not responding to the individual's demands—but even so, the sales of treatments that were not in accordance with WHO guidelines were substantial. Nevertheless, it is possible that if other clients tend to prefer a particular product, then the LCS might assume that a new client would as well. When LCS were asked what treatments were commonly requested by clients for paediatric diarrhoea, the most common response was the anti-microbial Flagyl (metronidazole).

Third, profit motives may override LCS' knowledge of appropriate treatments for diarrhoea management. Previous studies have found that variation in behaviour is associated with variation in the financial incentives of providers, in different contexts of comparison: between public and private providers (Siddiqi *et al.* 2002); when there is more or less competition (Bennett *et al.* 2013); and with changes in mark-ups (Iizuka 2011). A comparison of the average wholesale prices of products from six wholesalers in the Central and Greater Accra regions with the average retail prices charged to the mystery clients shows that both anti-microbials and anti-diarrhoeals offer a larger profit margin than ORS and zinc, by roughly US\$0.50–US\$1 per prescription. In addition, many providers who provide the recommended ORS and zinc combination are also providing anti-microbials, a choice that may be motivated by a desire to sell more products. Stockouts did not appear to play a major role in limiting zinc provision, as 71% of both the intervention and control LCS facilities had zinc¹⁶ in stock during their provider interview.

Fourth, it is possible that providers are not obtaining enough information about their patients to provide appropriate guidance. In particular, providers do not appear to be gaining much information about the details of the patient's symptoms.

Although anti-microbial use is not recommended for uncomplicated diarrhoea for children under five, it is the standard recommendation for children with blood or mucus in the stool. However, only 6% of the LCS visited by a mystery client inquired about the presence of either of these symptoms. In contrast, 11% asked about a fever, 18% asked about vomiting and 52% asked about the duration of the child's diarrhoea. A full 37% asked *no* questions about the symptoms.

While knowing an appropriate treatment is an important step towards actually choosing to provide the appropriate treatment, this study shows that interventions that improve provider knowledge of appropriate practices may be insufficient to change actual practices. Other factors that are likely to play a role in provider behaviour deserve attention in future research.

Conclusion

This study evaluated an SMS intervention designed to reinforce the provision of information about proper management of uncomplicated childhood diarrhoea among LCS in Ghana. The SMS campaign improved providers' reported compliance with WHO standards, as evidenced by an increase in LCS reporting that they most commonly recommend ORS and zinc and a decrease in reported provision of anti-microbials. However, this did not translate into improved practices, as measured in the actual products provided to mystery clients.

This study contributes to the literature about the effectiveness of information interventions in changing health provider behaviour, showing evidence of improved reported practices unaccompanied by improvements in actual practices. The use of mystery clients to measure actual practices provides valuable evidence about the limits of such interventions in improving child health. The substantial gap between reported and actual practices underlines the importance of measuring actual behaviour in assessing impacts. Further work is needed to identify additional interventions to improve provision of health services in the management of childhood diarrhoea.

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Ethical approval

This study was reviewed and approved by the Ghana Health Service Ethical Review Committee and the Abt Associates Inc. Institutional Review Board. Free and informed signature of consent was obtained from all subjects. See ethical considerations section for additional details.

Conflict of interest statement: None declared.

Endnotes

- ¹ The WHO only recommends treating paediatric diarrhoea with anti-microbials if there is blood in the child's stool. These guidelines also state that metronidazole and amoxicillin (the two anti-microbials most commonly dispensed by LCS in our study) are not recommended, because they are ineffective for shigellosis, the most common cause of bloody stools in children. The WHO also notes that bloody diarrhoea is rarely caused by parasites and only recommends antiprotozoal drugs if laboratory tests indicate amebiasis or giardiasis. In addition, the guidelines outline that anti-diarrhoeals are never appropriate for paediatric diarrhoea.
- ² For the rest of the article, LCS refers to both the licensed chemical sellers and their assistants who attended the trainings and who help clients in the LCS shops.
- ³ While we consider providers' self-reported paediatric diarrhoea treatment practices as a proxy for their knowledge of appropriate treatment options, we acknowledge that self-reported practices

may also reflect other factors such as the salience of different treatments.

- ⁴ For exceptions, see Riley and BonTempo (2011) and Zurovac *et al.* (2011).
- ⁵ LCS is an important source of care for childhood diarrhoea in Ghana. According to the Ghana 2008 DHS, among caregivers whose children had diarrhoea, 22% went to a private sector provider such as a pharmacist, drug peddler or LCS (Ghana Statistical Service *et al.* 2009).
- ⁶ LCS who do not attend trainings required by the Ghana Pharmacy Council face a fine of 20 GHS, double the price of the training, when renewing their license.
- ⁷ The exact total number of LCS facilities in these districts is unknown. The SHOPS project obtained registries of LCS that showed 3058 total LCS in these districts, but upon holding the training sessions, these lists (initially used as a sign-in sheet) were determined to be out of date and included many LCS that were no longer in operation.
- ⁸ Although ORS, anti-microbials, and anti-diarrhoeals have been available in Ghana for many years, zinc tablets for the management of diarrhoea were introduced into the commercial market only in January 2012.
- ⁹ Out of the total of 910 shops, there were 40 shops (80 individuals) included in our study that sent two individuals to the training. The unit of assignment was the shop, and the number of attendees from a facility did not change the probability of selection. If a shop was selected, all attendees from that shop who provided phone numbers received the messages.
- ¹⁰ Of all the LCS to whom the SMS messages were sent, 59% responded to at least one quiz.
- ¹¹ The most common reasons for inability to interview shops were logistical factors: the shop had gone out of business (25%); the firm was unable to locate the shop (24%); the shop had already been interviewed during the pilot (16%); or the mobile phone was turned off when the shop was called to ask permission to interview and for directions to the facility (13%).
- ¹² These languages were Ga and Akan.
- ¹³ A thoughtful discussion of decisions around debriefing when participants do not know they are being watched is provided by McClelland (2012).
- ¹⁴ This question was asked a second time, with 'most often' replaced by 'second most often'.
- ¹⁵ For consistency in the measurement of the impact of treatment, we used the open-ended questions for all outcomes.
- ¹⁶ The interviewers were instructed to confirm whether the LCS stocked Zintab, the only paediatric diarrhoea-specific product on the Ghanaian market at that time. Other products such as vitamins with zinc were not included.

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