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Mobile phones, rent-to-own payments & water filters:

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Jill E. Luoto¹ and David I. Levine

Uptake of safe water products remains low, in spite of modest cost. We experimented with a sales offer that combined a free trial and rent-to-own payments for durable filters. Purchase rates doubled under this sales offer to 31% compared to a traditional lump-sum sales contract. To lower transaction costs we collected payments using Kenya's vast mobile banking network, MPESA. Mobile repayment rates were low; many filters were paid only when a vendor came in-person to request payment, which adds social pressure. While the rent-to-own offer is attractive, more work is needed to reduce transaction costs in rural and peri-urban Kenya.

Contaminated drinking water contributes to the deaths of 750,000 children under age five every year due to diarrheal diseases.¹ A number of randomized controlled trials have shown that low-cost point-of-use (POU) ceramic water filters are microbiologically effective and, when used, improve health.²⁻⁸ In several studies, consumers preferred water filters to chlorine-based point-of-use treatment,⁹⁻¹¹ which may lead to higher and more consistent usage over time.¹² Gravity-driven filters that feature built-in safe storage also are easier to use than many other POU treatment options – with filters, you just add water. All told, filters may be the most promising point-of-use water treatment option for achieving scale and sustained usage.¹³⁻¹⁵ Nevertheless, neither filters nor other point-of-use water treatment products are widely or consistently used anywhere in the developing world.

Like many durable health products, water filters face several barriers to their initial uptake. First, filters have a relatively high upfront cost, and many consumers face liquidity constraints so may not be able to pay for them. In addition, some consumers may have present bias, which reduces willingness to spend today for future benefits, even when those benefits are significant. Most consumers are also unfamiliar with how well filters work and with their effectiveness in improving water quality.

A sales contract that combines a free trial with 'rent to own' installment payments can address all of these barriers. The free trial allows customers to learn about the filter and whether they like it. 'Rent to own' payments that start at the end of the free trial can help to overcome liquidity constraints by allowing poor consumers to pay in installments over time. Finally, by giving the customer the filter at the start of the sales contract, we potentially overcome any present bias preventing the uptake decision. A similar sales contract resulted in a more than ten-fold increase

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in take-up for efficient cookstoves in Uganda: from 4% to 44% for a charcoal-burning stove in urban areas and from 5 to 55% for a wood-burning stove in rural areas.¹⁶ It is plausible that similar sales offers can increase purchases for many other goods that share similar barriers to their uptake, such as modern fertilizers, long-lasting insecticide-treated bednets, and solar lights. We tested this model for selling filters in Kenya.

However, the Uganda marketing trial involved in-person collection visits for the installment payments, which are costly and difficult to scale. We tested whether making installment payments via mobile banking can overcome liquidity constraints and present bias with much lower transaction costs. We tested this hypothesis in Kenya, where access to mobile phones has skyrocketed in recent years and the mobile banking system M-PESA is widespread: 83% of Kenyans aged 15 or over were estimated to have access to a mobile phone in 2010,¹⁷ and as of 2011, 72% of Kenya's poor – those living on less than \$1.25/day and outside Nairobi - had used MPESA's services.¹⁸ This region also has widespread unsafe local water, and many households who aspire to own filters.

This article presents results of a larger study among 300 randomly selected households in Kenya to whom we offered filters for sale. We call our sales model MPOT, for Mobile Payments Over Time (filters are often informally called “pots” in this part of Kenya).

2. Background

2.1. Study setting

The project was located in Western and Nyanza provinces, two of the poorest provinces in Kenya. Most of the rural water is a combination of piped water to public taps and surface (river and ponds) water, almost all of which has bacterial contamination, or allows for recontamination between the point of collection and consumption.^{9,19} Urban water is usually either piped (whether to a public tap or to private homes or plots) or, most often in informal settlements, also can be from shallow wells or water vendors. Thus, even in urban areas people are often still reliant on sources that can have bacterial contamination.²⁰ While most people are aware that water is sometimes unsafe, few treat their drinking water reliably and consistently.^{9,19,21}

Although quite poor, as of 2010, an estimated 83% of Kenyans aged 15 and over had access to a mobile phone.¹⁷ Moreover, in 2011 72% of those living on less than \$1.25 a day and outside of Nairobi, Kenya's capital, were estimated to have used M-PESA.

Our study examined sales of the Cera Maji ceramic filter (Figure 1). Gravity-driven ceramic filters such as the Cera Maji are among the most common water filters in developing countries, in part because they can be manufactured locally almost anywhere. To use this filter, users pour untreated source water into a top inner bucket that has a ceramic filtering element at its bottom. Gravity causes the water to be filtered through tiny pores in this ceramic piece into a lower bucket from which safe water is drawn with a spigot.

2.2 The Safe Water and AIDS Project (SWAP)

SWAP was the local implementing partner for this study. SWAP is a non-governmental organization operating since 2005 in western Kenya with its headquarters in Kisumu and 8 satellite offices located throughout western Kenya. SWAP serves as an umbrella organization with a network with over 400 local “Community Health Promoters” (CHPs) who sell health-promoting goods in their communities as a form of income generation that also benefits the wider community. CHPs are local women and men (mostly women) drawn from vulnerable HIV support groups and community self-help groups throughout Western and Nyanza provinces. They receive some training in health and sales and distribute health-related goods such as bednets, liquid chlorine and nutritional supplements from SWAP’s “basket of goods.” They are also provided with a bicycle which is modified to carry products in a basket (hence “the basket of goods”) which they use for their door-to-door sales. They map their area and each is given household and sales targets to meet. Each CHP sells to a specific neighborhood, typically as a part-time job.

SWAP purchases the filters from Kenya Ceramic Project based in nearby Western Kenya.²² The network of SWAP CHPs normally sell about 100 Cera Maji filters per month using a traditional lump-sum sales offer at a price of 1400 Kenyan Shillings (Ksh; about \$16.25). This price represents full cost recovery,² yet take-up remains very low at less than 1% of consumers in the areas where SWAP CHPs sell goods.

The 150 Ksh mark-up CHPs receive on the 1400 Ksh filter (more than 1 day’s wage in this area) is far more than the 1-10 Ksh CHPs receive on the typical products they sell such as soap and consumable chlorine-based water treatment products. At the same time, filters are bulky, heavy and fragile. Thus, CHPs do not carry filters to sell them in their household sales visits and few customers know much about the filters.

2.3 M-PESA

Kenya’s mobile banking service M-PESA (M stands for mobile, and Pesa is Swahili for money) is an SMS-based money transfer system that operates throughout the country and has enabled many millions of Kenyans who otherwise lack formal banking services to be able to transfer money across long distances and pay for goods and services using their mobile phones.^{17,23,24} M-PESA is run by Kenya’s largest mobile network operator, Safaricom, which controls 80% of the mobile market.¹⁷ As of 2011, an estimated 16 million users have M-PESA accounts in a country of 22 million adults aged 15-64 (~73%).²⁵

An M-PESA customer can deposit, withdraw or send money by SMS to another customer by visiting one of 25,000 agents across all parts of the country.²⁶ Agents often operate out of local retail shops, street vendors, petrol stations, etc.

Users do not pay to create an M-PESA account. Normally, users pay 30 Ksh (roughly \$0.25) to send a payment. For this study, SWAP used MPESA’s *PayBill* service to cover the transfer fees on payments from customers. Due to its nonprofit status, SWAP received a discount price of 20 Ksh per transfer for this project.

² SWAP pays 1100 Ksh to Kenya Ceramics for each filter, and includes a markup of 150 Ksh to offer CHPs the wholesale price of 1250 Ksh. The CHPs in turn have a 150 Ksh mark-up to form the market price of 1400 Ksh.

Initially, SWAP assumed this plan would entail an average of 4 MPESA transfers per customer (at a cost of 20 Ksh each), each preceded by 1 SMS reminder at a cost of 1 Ksh apiece, for a total intended subsidy of 84 Ksh, or 6% of the retail price of the filter (1400 Ksh).

3. Evaluation Methodology

We conducted a door-to-door sales experiment with 300 households in peri-urban Kisumu and rural areas within two hours' drive of Kisumu across five satellite offices of SWAP: Kisumu, Homa Bay, Siaya, Nyando and Kakamega. The first four sites are in Nyanza Province with populations mostly of the Luo tribe. These areas are generally close to Lake Victoria. Kakamega is in Western Province whose population is predominantly Luhya. This area is further from the lake and contains more subsistence farmers and small businesses. Kisumu, Kakamega and Homa Bay have urban, peri-urban and rural settings, while Siaya and Nyando have peri-urban and rural settings only.

In each of the 5 SWAP offices the office manager selected two neighborhoods that were sufficiently distant such that neighbors would be unlikely to hear of the other offer within the few weeks we were making sales offers. We assigned offers at the neighborhood level to avoid issues of jealousy across neighbors.

After the office manager selected the two neighborhoods in the catchment area of each Satellite Office, they then assigned a CHP and sales offer to each neighborhood. (We had intended each CHP to cover two smaller and disjoint neighborhoods, one randomly assigned each sales offer, but failed to communicate this study design clearly to the implementation team.) Interviews with the office managers indicate that they chose CHPs who were active and lived near the neighborhoods chosen for this study. They also chose CHPs with above-average education, to facilitate explaining the features of the filter according to our marketing script.

CHPs received their standard 150 Ksh commission on each filter sold. For sales made with rent-to-own installment payments, we told CHPs the commission would be paid after the filter was paid off. In fact, commissions were delayed roughly six months until all collections were completed (details below).

Within each neighborhood, the CHP selected homes at random, subject to the rule that each home not be visible from the prior home (to reduce social influence). CHPs then gave a detailed presentation of the Cera Maji filter. A copy of the marketing presentation is in the Appendix.

A day or two after the sales visits by CHPs, SWAP survey enumerators visited a household and asked to speak to the mother of the youngest child. We targeted mothers of young children because children enjoy the largest health benefits from safe water.²⁷ Kenyan households are often comprised of extended and polygamous families so there is often more than one mother in a single household; households with no children were still eligible for inclusion in the survey.

After confirming that the household had access to a mobile phone (or had a neighbor who could relay SMS messages; this was the only criterion CHPs were instructed to ensure prior to making a sales presentation) and recording their mobile number(s), enumerators conducted a baseline

survey of household demographics, basic assets, current water sources and water treatment, sanitation and hygiene behaviors, knowledge of the dangers posed by untreated local water supplies, and familiarity with the Cera Maji filter and with competing point-of-use options (primarily WaterGuard bleach solution).

In the 5 neighborhoods assigned to the control group (n=150 households), CHPs made a traditional sales offer for the full price of the filter in one lump sum payment of 1400 Ksh (about \$16.25 at the exchange rate of the time). CHPs offered to return in one week to deliver the filter and collect payment if the respondent wanted time to speak to family members or gather funds.

In the 5 neighborhoods assigned to the treatment group (n=150 households), CHPs made the MPOT's novel sales offer of a free trial, rent-to-own payments, and the right to return the filter and stop future payments. The CHP explained that households accepting the free trial would receive an SMS reminder message in two weeks requesting an MPESA payment, or the household could ask the CHP to return to pick up the filter. The CHP also explained that SWAP paid the money transfer fees for customers' MPESA installment payments. Acceptors of the MPOT sales offer signed a contract outlining the terms of this offer (in an effort to ensure their understanding and secure their commitment to its terms; see Appendix for a copy of this contract). The free trial began at the end of the CHP's sales visit.

SWAP used *Frontline:SMS Credit* software to automate collection of payments and sending of SMS reminders. SWAP sent SMS messages one and two weeks after the start of the free trial, and then every two weeks thereafter. Their content is listed in Table A1 in the Appendix.

For most households, the second payment came due during the 2012 Christmas holidays, and in January 2013 school fees were due. Thus, we choose to extend the period of payment beyond the initial schedule of six weeks. CHPs and SWAP staff were unhappy at the prospect of repossessing filters, which contributed to the extended free trials. Unfortunately, that delay brought us to the end of February, which was too close to the national elections in early March to permit field operations. The previous national election in Kenya resulted in near outbreak of civil war, so staff did not go into the field prior to or immediately after the election.

During the roughly six months of follow-up, households owing money received up to eight SMS and two or three follow-up phone calls. A subset also had in-person visits.

Finally, in June 2013 SWAP research staff (usually accompanied by the original CHP) visited customers to repossess those filters that had not been paid in full. These visits were pre-announced to customers via SMS or a phone call. Consumers had the choice to complete payments at that time. SWAP also refunded any payments of over 200 Ksh on filters it repossessed. (The 200 Ksh was deemed a "rental fee" for nearly 6 months of treated water.)

3.1 Pilot results

Prior to the larger test on 300 households, we carried out a small initial pilot study selling Cera Maji filters with the novel sales offer and M-PESA. Results were encouraging. Ten of 16 households in peri-urban areas of Kisumu that were presented with the novel offer accepted the free trial. In total, 85% of payments were made on time, and 96% of revenue was collected in this small pilot. Of the 10 customers, just one returned the filter and stopped payments before

completing the purchase. Importantly, no households stopped payments and refused to return the filter.

We inadvertently ran a second pilot as well. Prior to the start of our larger study on 300 households, four of the CHPs trained into the MPOT model made the sales offer to customers they hand-selected. These customers were often from groups they belonged to, such as a church group or a self-help group. The four CHPs made 66 offers and had uptake from 51 consumers (78%). We were told by the field officer (who supervised two of the relevant CHPs) that group members would see the filter in action during product demonstrations in these groups and agree among themselves to purchase filters under the MPOT plan.

In this inadvertent pilot, two filters were repossessed and one customer bought two filters. In total, SWAP was paid fully via MPESA for 24 filters (47% of the uptake), and the average customer paid 884 Ksh total of the 1400 Ksh price (63%). Thus, when SWAP CHPs were able to hand-select their customers, they earned 63% of revenue on 50 sales to 49 households, all collected via SMS and MPESA, with minimal follow-up.

3.2 Balance across study arms

With regards to our larger (random) sample of 300 households, we had balance on a number of survey characteristics across treatment groups, allaying concerns about non-random treatment assignment. Table 1 contains results of these comparisons with standard errors clustered at the level of neighborhoods (the unit of assignment of sales offers). Across treatment and control neighborhoods we find similar rates of permanent roofing, floor and wall materials, as well as similar rates of ownership of basic assets and water treatment behaviors.

We created an “asset index” that counts the numbers of assets owned from a list of 12 asked about in our baseline survey (details in notes to Table 1). Overall, households in the neighborhoods with the lump sum offer had an average of 4.08 of the 12 assets while households in neighborhoods with the MPOT offer had an average of 4.05. The tiny difference is neither economically nor statistically significantly different.

The only baseline variable with a statistically significant difference across treatment groups is the number of children less than five years of age, where the households in the treatment group have an average of 0.2 more young children ($p=0.05$). However, there is no statistically significant difference in the *rates* of households with children less than five (p -value of 0.28), suggesting this is likely due to chance given the large number of comparisons made.

3.3 Summary Statistics

As shown in Table 1, the mean respondent age was 38 and 94% of respondents were female. On average respondents had about 4 children, one of whom was aged 5 or under.

As we screened our respondents for having access to a mobile phone, we see in Table 1 we do not capture the poorest of the poor. A significant majority have an iron roof (93%) and access to some form of sanitation (just 13% report defecating in open fields). Less than half of respondents

(48%) have access to piped water or rain water collection means (and even these sources are often contaminated). 73% of respondents reported they do not consistently treat their water.

Vestergaard Fransen had distributed free LifeStraw® filters in 2011 to all households in Western province, in which the Kakamega satellite office of SWAP is located. These filters are smaller and generally reported as harder to use than the Cera Maji filters we were selling. Of the 60 Kakamega households we visited for our study at baseline, 15 (25%) reported “occasional” usage of their LifeStraw filter. The rest did not mention even having their LifeStraw filters any longer. Ten of these LifeStraw self-reported users were among 30 households in the traditional sales offer neighborhood and 5 among the 30 households in the MPOT sales offer neighborhood.

None of the 300 households we visited had a Cera Maji filter at baseline.

4. Results

Our basic analysis comes from estimating how the MPOT sales offer affects uptake, controlling for characteristics of the catchment area of each satellite office f with a series of satellite office dummies (F_f):

$$1. \quad Y_{ifn} = \alpha + \beta MPOT_n + \sum_f \delta_f F_f + \varepsilon_{ifn}$$

Here, Y_{ifn} is an indicator that equals 1 if respondent i from neighborhood n within the catchment area of satellite office f purchased a filter (and 0 otherwise). $MPOT_n$ indicates if neighborhood n received the MPOT (=1) or traditional sales offer (=0), and the δ_f are coefficients on the office dummies. We cluster the error term ε_{ifn} at the neighborhood level to allow for correlated outcomes within neighborhoods that shared a common CHP and sales offer.

The traditional offer had 16% uptake (24 sales at 150 homes, Table 3, panel A). This rate was higher than we expected, given low take-up prior to our project.

The MPOT offer of a free trial followed by rent-to-own mobile payments had 31% uptake (47 filters distributed to 150 homes; Table 3, panel A column 2), which is statistically significantly higher than at control homes ($P < 0.01$, adjusting for clustering by neighborhood in estimation of equation 1 – see column 3 of Table 3). SWAP collected 93% of scheduled revenue on these filters. Three of the 47 filters were neither returned nor fully paid for.

4.1 Results by satellite office

A single one of the 5 CHPs assigned to the traditional sales offer, in Kakamega, made the majority of the sales under this offer. That CHP made 14 sales from 30 visits (47% uptake), while the other 4 CHPs making the traditional offer made 10 sales from 120 visits (8%; see column 1 of Table 3’s panel A).

We cannot be sure, but higher uptake in Kakamega may have been due in part to the quality of that CHP: he was an active CHP prior to this study and highly visible in promoting community health. In fact, he sold 11 filters during his regular (non-study) operations in the two months preceding our study, which very loosely corresponds to a monthly purchase rate of 6% in his catchment area. This compares very favorably with an average monthly purchase rate of <1% for a typical SWAP CHP (i.e., the average CHP does not sell a Cera Maji filter in a typical month to his or her customer base).

However, Kakamega is also unique insofar as it was the only SWAP office located in Western (not Nyanza) province with a predominantly Luhya (not Luo) population. Kakamega also appears somewhat wealthier than the other satellite offices when we look at our asset index (Table 2), although we cannot reject equality across the 5 offices on this measure.

Kakamega was also the only office located within the catchment areas of Innovation for Poverty Action (IPA)'s chlorine dispensers as well as the freely distributed LifeStraw® filters from Vestergaard Fransen. However, no households at baseline reported usage of the chlorine dispensers. As mentioned above, 10 of the 15 customers who reported any usage of their LifeStraw filter were assigned to the traditional offer, and 5 were assigned to the MPOT offer. Of these 15 customers, just 1 (7%) accepted their assigned sales offer for the Cera Maji (under the traditional offer). This share of uptake among LifeStraw “occasional” users is much lower than the 64% uptake among the 45 customers within the Kakamega catchment area who did not report having or using a LifeStraw filter (13 of 20, or 65%, of those given the traditional offer, and 16 of 25, or 64%, of those given the MPOT offer).

4.1 Free trial, purchase and returns

Panel B of Table 3 breaks down the results from our MPOT intervention into greater detail. The initial free trial was accepted by 52% of homes who received the novel offer (78 out of 150). Thus, 56% of those who accepted the filter paid for it fully by the end of our study (44 of 78; see column 3 of Table 3, panel B).

Three households neither returned nor paid for their filters (3.8% of free trials). In one case the wife separated from her husband and took the filter when she moved to a different district. In a second case the customer died. In the third case, the customer was simply never again found by phone or in-person visits. Thus, as in the two Uganda studies,¹⁶ the rate of neither returning nor paying for the filter was low.

Unlike with the two studies of stoves in Uganda, the return rate for the filter was high, 40% of free trials (31 of the 78, compared to 6% and 8% in the urban and rural Uganda studies). There is suggestive evidence supporting several possible reasons for the higher return rate in this study.

First, the sales offer was typically made to the wife, while the husband almost always owned the phone and received the SMS text messages asking for payments. Kenyan women are usually responsible for water treatment, but husbands usually have input (if not sole discretion) on the household's finances and purchases of major household items.¹⁹ In some cases, the husband had not even been informed of the free trial or terms of the sales offer. In addition, many husbands were less interested than their wives in the filter.

In other cases the consumers liked the filter but could not afford it. For example, in one case a widow's brother-in-law was visiting and accepted the free trial. (In Luo culture, the brother-in-law is head of the household for his brother's widow.) When the brother-in-law returned to his own home (taking his mobile phone with him), the widow had no funds to purchase the filter. In other cases, consumers had originally hoped to be able to afford the filter, but their incomes were lower or other expenses higher than they had hoped.

Our extended free trial may have promoted a return at one household. They used the filter for six months. A household member knocked the filter over and broke the ceramic piece a few weeks prior to repossession. Thus, when SWAP came to repossess the filter the household paid nothing. The household said they would purchase a new filter, but has not yet done so.

Finally, for a few customers, the filter was not that attractive to some who accepted the free trial. That is, our observers saw evidence the household was able to afford the filter, but chose to return it. The main complaint reported in these instances was disappointment that the filter did not keep the water cool. (Although this was a small overall complaint.)

The return rate was not only high, it almost always very delayed. Only 3% (1 of 31) of returns occurred at the end of the scheduled free trial.

In contrast, most returns (30 of 31) required SWAP staff to come to the household and repossess the filter after roughly six months of SMS reminders and phone calls. The typical consumer who kept the filter for many months had repeatedly claimed he or she would soon pay, but never did. Kakamega again stands out, where 100% of those who accepted the MPOT sales offer from this office paid off their filters with zero returns (Table 3, panel B, column 3).

4.2 Delays in paying

Payments, like returns, were usually much slower than the original sales agreement. Of the consumers who purchased the filter under the MPOT sales plan, only 20% (9 out of 44) completed payments within the scheduled six weeks plus two weeks' grace period. The rest (80%) finished paying late. Only 7 of the 44 paying MPOT customers made four complete payments, while 10 customers made three payments (fewer than scheduled). Surprisingly, 14 of the 44 buyers paid one lump payment despite the opportunity to stagger payments (although 9 of these payments were at the repossession visit many months later).

As noted above, part of the delay in paying was due to the timing of the initial sales offers, with the Christmas holidays, school fees, and the potentially violent election all delaying some payments.

4.3 MPESA as a barrier

At the same time, much of the delay appears to be due to MPESA being a less-than-ideal means for collecting installment payments.

First, some SMS did not get through. Some recipients did not have a charged phone and some had changed phone numbers. In other cases, we gave free trials to households where only a neighbor had a phone, and fewer SMS arrived when the household required help from a neighbor. Similarly, we presented the sales offer to wives, but husbands typically owned and carried the phone.

Although we screened households based on willingness to use MPESA, some customers were unfamiliar with sending money (versus receiving money). Conversations at the end of our study with various customers and CHPs also revealed that the PayBill system, in which money is sent to a business without the customer paying any fee, further confused some respondents. There were a few instances of customers sending money to the CHP, not to SWAP. SWAP staff ended up having to train a number of respondent households on the PayBill service, and produced a leaflet of instructions for this purpose.

Roughly two-thirds of eventual buyers (29 of 44) only completed payments when SWAP staff showed up in-person to request payment or to repossess the filter after SMS messages went ignored. In total, 34% of the total collected revenues for the MPOT homes were done in-person, while 43% of MPOT customers paid entirely via MPESA (19 of the 44 customers who paid in full).

Furthermore, for the customer there is a transaction cost in terms of their time to visit an MPESA agent to send a payment. Due to our use of random sampling for the study, some customers were located quite far from an MPESA agent in practice. Sending money via MPESA also allows customers to procrastinate on paying more easily than does an in-person request, which likely includes an added degree of social pressure to comply with the sales contract. Finally, there is the question of whether the SMSs were perceived as a credible threat. Because the SMS messages sent by SWAP had requested payment but offered no consequences from non-payment, many customers likely simply enjoyed extending their free trials.

4.4 Other notable results

Filter usage

The filter was popular. Consumers reported the Cera Maji filter makes the water taste and look better than WaterGuard or other chemical treatments. The filter is also simple for all household members to use, including children. Even when customers returned the filter, almost all were using it when SWAP staff visited to repossess them.

Consumer heterogeneity

The random selection of consumers may have contributed to the late payments and many returns. The inadvertent pilot described above, when CHPs chose their customers for each sales offer, suggests that the MPOT offer may be more effective when CHPs are allowed discretion in choosing their customers. However, this might imply CHPs choose wealthier customers on average or customers with whom a CHP is familiar, or both.

In Table 4 we break down results of the characteristics of those who accept or reject their sales offers to test for any differences from our random sample of 300 households. Specifically, we test whether those who purchase their filters (under either sales plan) look different than those

who refuse their offers; we also test whether purchasers under the MPOT plan look different than purchasers under the traditional sales plan (the controls). Because the decision to accept or reject an offer is nonrandom, these results are descriptive and do not imply any causal relationships.

Contrary to our expectations, we do not see evidence that the MPOT offer was able to reach poorer segments of the population than was the traditional sales offer. Acceptors of both offers had higher wealth indices on average. However, we recognize that we lack sufficient power to test this hypothesis formally.

Interestingly, the MPOT sales offer reaches more families with young children than does a traditional sales offer. Although this may be a spurious result as it is based on an analysis that was not planned prior to data collection, if this result generalizes it could be encouraging since young children benefit the most from safe drinking water.

The MPOT model for filters may have been particularly effective at getting non-consistent treaters into water treatment: 65% of those who reported inconsistent water treatment at baseline and accepted the MPOT offer paid off their filters by study's end (34 of 52 acceptors), versus 38% (10 of 26 acceptors) of those who said they always treated their water at baseline, a 27 percentage point difference (p-value = 0.10 taking into account clustering). Although this result is only suggestive, if it generalizes it would be encouraging news that our model was particularly effective at drawing into water treatment those households that for one reason or another do not like or value other water treatment methods, and upon learning that they indeed value the filter, they were willing to pay for it.

Cost-effectiveness

As stated earlier, the original plan assumed that SWAP would provide a subsidy of roughly 84 Ksh per purchased filter under the MPOT plan, or 6% of the retail price (about \$1). In practice, the average customer who accepted the MPOT sales offer received 8 total SMS, 2.4 phone calls, and 1.2 in-person visits. These costs would roughly double the subsidy per filter to about \$2.

However, the high return rate greatly increases costs of the project. Depreciation on the returned filters would add roughly another \$4 of losses per filter sale (31 returns for 44 sales, with a depreciation rate of perhaps 35%), or an extra 25% of sales revenue – a much higher subsidy than is likely to be scalable. Finally, due to the bulkiness of the filter and the high rate of returns, SWAP used vehicles to repossess unpaid filters. The cost of a vehicle makes this model very far from cost-effective.

5. Summary and Conclusions

As in previous research for cookstoves in Uganda, the free trial followed by rent-to-own substantially increased uptake of a relatively unfamiliar health-promoting durable good. No households were found to own a Cera Maji filter at baseline and by the end of our study, 31% of those offered a filter under the MPOT plan had accepted (and 93% of revenues due were paid).

When a handful of these paying customers were visited some months later by project staff, all were found to still be using their Cera Maji filters, and all had positive reviews of their

experiences. This suggests that finding ways to increase access to these higher-margin safe water products is worthwhile.

This project was motivated by the hope that collecting installment payments by mobile phone banking would lower transaction costs, and thereby make this model potentially scalable across areas that share both unsafe local water supplies and have access to mobile banking. In this trial, those cost savings did not materialize due to the high rate of late payments and returns. Many payments necessitated an in-person visit to gain compliance.

Barriers

We identified numerous barriers to prompt and full payments.

Some of the late payments were due to SMS messages not getting through (often because the wife did not own her own phone); and the transaction costs of going to an MPESA kiosk.

Another barrier was that we made sales offers to wives, yet husbands often control a shared household phone and the household's finances.

Another barrier was lack of familiarity with sending money via MPESA, especially using the PayBill service for sending to a business. At the same time, given that SWAP had multiple communications prior to repossessions, including in-person visits to many homes, it is unlikely that lack of familiarity with MPESA was responsible for most late payments.

In addition, the late payments were *ex post* a rational strategy for many consumers. First, many households in our study area had received a free water filter or other free water treatment products from different NGOs at various earlier times. As SWAP made minimal efforts to repossess the filter, consumers may sensibly have considered it plausible that they could keep the filter indefinitely without paying. In addition, each period of non-payment extended an interest-free loan from SWAP and gave consumers a free option to return the filter if it broke before payment.

Finally, consumers who did not intend to pay (or who knew they were unlikely to have the funds), but claimed they would soon pay, enjoyed a free trial that ended up extending for over 6 months – permitting them to enjoy several dollars' worth of clean water services before SWAP repossessed the filter.

High return rates were a problem in addition to late payments. In contrast, in the two studies of stoves in Uganda almost all consumers who took the free trial purchased the stove. It is plausible the return rates in those studies were lower because the cookstoves, unlike the filter, saved money or time spent gathering fuel immediately.

Some returns were due to very poor households accepting the free trial. Other returns may have been due to consumers not understanding the filter's features; for example, wanting a product that kept water cool.

Implications

Many of the barriers suggest possible solutions.

It is likely the return rate would have been lower if: the vendors had marketed to both the husband and the wife; the filter were a more attractive product or had a lower price (perhaps with the help of carbon credits); the filter had benefits that consumers could recognize immediately; and, the vendors had done a better job of informing consumers of the filter's characteristics and cost, so more households that were a poor fit would have turned down the free trial.

Both return rates and late payments would probably have been lower if CHPs had selected customers (instead of sampling at random, as our study did). CHPs could be trained to make the offer only to households who: Own their own phone and routinely keep it charged (perhaps as demonstrated by sending the vendor an SMS); are familiar with MPESA; live or work near an MPESA kiosk; and have plausible ability to pay for the filter.

The MPOT sales model also may be a better fit for "male-oriented" goods such as farm inputs than for the filter, given common intra-household gender dynamics. Men often hold primary custody of a shared phone and enjoy primary input into the household's financial decisions, while women often place higher value on children's health and their own time, two key potential benefits from the filter.

It may also be useful for vendors to start with customers they know, as such customers are more likely to respond to social pressure from the vendor to make payments.

Moving to vendor-selected consumers will imply the sales offer will not be made to the very poorest of the poor. At the same time, even the middle of the income distribution in rural and peri-urban Kenya is very poor by global standards. In any case, a financially sustainable business model can only reach those who can afford the filter.

It is likely the rate of late payments would have been lower if:

- vendors had trained consumers on using M-PESA to make payments via PayBill;
- the vendor had a reputation of repossessing items when a customer is behind in payments;
- consumers paid fees for late payments or received a discount when payments were consistently timely;
- If there were direct withdrawal (perhaps from a linked savings account) via mobile banking (though not permitted under current mobile banking regulations in Kenya)

With several of these adjustments, it is possible that the rent-to-own with mobile phone payments could reduce late payments and returns sufficiently to become cost-effective, at least from a societal standpoint. We are currently exploring different models in light of these findings to increase uptake of important durable health products in potentially scalable ways. A large market exists for whomever overcomes pervasive barriers facing the poor including missing information on product quality and liquidity constraints.

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Figure 1: Cera Maji Ceramic Filter

Table 1: Baseline Respondent Characteristics by Treatment Status

Baseline Respondent Characteristics	Controls	Treatments	p-value
Female respondent	0.94	0.95	0.88
Respondent age (in years)	41.1	36.2	0.12
Number of children	4.30	4.00	0.62
Number of children less than five	0.84	1.06	0.05**
Permanent roof indicator	0.91	0.95	0.51
Permanent wall indicator	0.32	0.33	0.97
Permanent floor indicator	0.31	0.34	0.84
TV	0.37	0.34	0.83
Radio	0.90	0.84	0.33
Refrigerator	0.07	0.05	0.79
Bike	0.47	0.54	0.53
Mobile phone ownership	0.86	0.95	0.05*
Asset index (counts up to 12 assets)^	4.93	4.99	0.95
Baseline Water and Hygiene Knowledge and Behaviors			
"Safe" Water Source indicator	0.43	0.54	0.66
Use WaterGuard (ever)	0.57	0.54	0.90
Boil water (ever)	0.19	0.17	0.83
Use a Filter (ever)	0.24	0.26	0.90
Use Lifestraw Filter (ever)	0.07	0.03	0.72
Soap in home	0.92	0.96	0.32
Defecate in open field	0.15	0.11	0.75
Sum of correctly named hand washing moments (maximum of 5*)	3.1	3.0	0.73
Treat water every day/always	0.29	0.25	0.87
Observations	150	150	
^Assets included in index: tv, radio, bike, mobile phone, refrigerator, motorbike, car, household help, indicator for owning land, permanent roof, permanent wall, permanent floor.			
*Correct responses include: before food preparation, before eating, after eating, after visiting toilet, after farm work.			
P-values based on F-statistics that take clustering by neighborhood into account. "Safe" water means primary source is piped or rain water.			

Table 2: Asset Indices by Satellite Office

Office	Asset Index
Homa Bay	4.63 (0.26)
Kakamega	6.00 (0.30)
Kisumu	5.63 (0.28)
Nyando	4.98 (0.21)
Siaya	3.55 (0.23)
Total	4.96 (0.13)

Standard errors in parentheses clustered at neighborhood. Asset indices as defined in notes to table 1.

Table 3: Filter Take-up and Payment Performance

	(1)	(2)	(3)
Panel A:	Traditional	M-POT	OLS
Overall Results	Offer	sales offer	
Have filter at study's end	0.16	0.31***	
Purchase filter	0.16	0.29***	0.13 (0.02)***
Homa Bay	0.13	0.30	-
Kakamega	0.47	0.53	0.28 (0.03)**
Kisumu	0.10	0.13	-0.10 (0.04)**
Nyando	0.10	0.27	-0.03 (0.02)*
Siaya	0.00	0.23	-0.10 (0.04)**
Constant			0.15 (0.02)***
Observations	150	150	300
Panel B:	Accept	Return	Complete
MPOT Households only	Free Trial	filter	Payments
		unpaid	via MPOT
Overall	0.52	0.40	0.56
Homa Bay	0.50	0.33	0.60
Kakamega	0.53	0.00	1.00
Kisumu	0.33	0.60	0.40
Nyando	0.60	0.50	0.44
Siaya	0.63	0.58	0.37
Filter loss (neither return nor paid for)		0.04	
Observations	150	78	78

Notes: *** P<0.01; **P<0.05; *P<0.10. Calculation of statistical significance based on OLS estimation of equation 1 with errors clustered at neighborhood. Each office had N=60 observations, equally split into treatment and control groups (10 neighborhoods total). In Panel A, columns 1 and 2 present mean outcomes overall and by office. Column 3 presents results from estimation of equation 1 with satellite office dummies and standard errors in parentheses. Homa Bay is the excluded category.

Table 4: Breakdown of characteristics of who accepts or rejects given sales offer

	Treatments						Controls			T vs. C
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Baseline Respondent Characteristics</i>	Reject Free Trial	Accept Free Trial	p-value (Accept vs. Reject)	Do not purchase	Purchase filter	p-value (purchase vs. no)	Do not purchase	Purchase filter	p-value (Accept vs. Reject)	p-value (T vs. C for purchasing filter)
Female respondent	0.97	0.92	0.49	0.94	0.95	0.79	0.93	1	0.24	0.36
Respondent age (in years)	34.68	37.51	0.21	34.21	40.83	0.05**	41.11	40.75	0.76	0.98
Number of children	3.76	4.19	0.14	3.88	4.22	0.15	4.55	3.04	0.01**	0.06*
Number of children less than five	0.99	1.13	0.55	1.1	0.98	0.62	0.88	0.63	0.00***	0.10*
Permanent roof indicator	0.94	0.96	0.38	0.93	1.00	0.14	0.90	1.00	0.18	-
Permanent wall indicator	0.24	0.41	0.17	0.27	0.48	0.27	0.25	0.71	0.07*	0.37
Permanent floor indicator	0.23	0.45	0.08*	0.27	0.52	0.06*	0.26	0.59	0.28	0.83
TV	0.17	0.49	0.05**	0.24	0.57	0.12	0.31	0.71	0.02**	0.46
Radio	0.80	0.87	0.24	0.83	0.86	0.51	0.90	0.92	0.73	0.51
Refrigerator	0.01	0.09	0.20	0.03	0.11	0.12	0.06	0.13	0.23	0.92
Bike	0.46	0.62	0.03**	0.49	0.66	0.14	0.49	0.38	0.33	0.07*
Mobile phone ownership	0.97	0.94	0.83	0.96	0.93	0.74	0.86	0.96	0.08*	0.67
Asset index	4.19	5.71	0.06*	4.46	6.25	0.10*	4.63	6.50	0.03**	0.78
Observations	70	78	150	106	44	150	126	24	150	68

Notes: *** P<0.01; **P<0.05; *P<0.10. All p-values take into account clustering by satellite office. Columns 1 and 2 present mean summary statistics for who accepts versus rejects the offer of a free trial under MPOT. Columns 4 and 5 compare mean characteristics of those who purchase versus do not purchase under MPOT. Columns 7 and 8 make a similar comparison of purchasers with non-purchasers under traditional sales offer. Column 9 compares statistical significance of purchasers under MPOT with purchasers under traditional offer (i.e., testing column5 versus 8). “Asset index” includes count of how many of the following household assets are owned: tv, radio, bicycle, mobile phone, refrigerator, motorbike, car, household help, indicator for owning land, permanent roof, permanent wall, and permanent floor.

Appendices

Table A1: Content of SMS messages sent to MPOT households who accepted

Weeks after starting free trial	Approximate content of the message
1 st week after free trial	Hallo, I hope the filter works best for you. Remember your free trial time is over and you should now start paying. Thanks Aloyce Swap
2 nd week after free trial	Hallo, continue using the filter to make your water safe for drinking as you continue paying for it as well. Thanks Aloyce Swap
Roughly every 2 weeks thereafter	For those who had completed paying: “Thanks for the completion of your payment.” Those who had not completed payment were sent the same message as above at 2 nd week.
Last weeks prior to recollection for non-payers	Hallo, Remember safe water is good for your health and the health of your family. Complete your payment as we agreed before we collect back the filter. Thanks.

Filter Promotion Script at CHP visits – READ TO ALL HOUSEHOLDS (MPOT’s Novel and Traditional sales offers)

Preventing Diarrhea

How do you prevent diarrhea? [pause. Agree with all correct answers]

1.): _____ DO NOT READ THE CHOICES. PROMPT THREE (3) TIMES. INDICATE 1=NAMED; 2=NOT NAMED, FOR EACH OPTION BELOW.

- [-----] (a) THERE IS NO WAY TO PREVENT DIARRHOEA
- [-----] (b) BOIL DRINKING WATER
- [-----] (c) DRINK ONLY CLEAN WATER
- [-----] (d) USE LATRINE
- [-----] (e) PROPER COOKING OF FOOD
- [-----] (f) DON’T EAT SPOILED FOOD
- [-----] (g) EAT CLEAN/PROTECTED/WASHED FOOD
- [-----] (h) WASH HANDS
- [-----] (i) SOLAR WATER DISINFECTION
- [-----] (j) GOOD HYGIENE PRACTICES
- [-----] (k) DON’T EAT TOO MUCH
- [-----] (l) MEDICATION
- [-----] (m) CLEAN DISHES/CLEAN UTENSILS
- [-----] (n) BREASTFEEDING
- [-----] (o) USE COMPOST PIT/KEEP COMPOUND CLEAN
- [-----] (p) LEAVE WATER IN THE SUN

To know how to prevent diarrhea, we have to know how you get diarrhea.

How do you get Diarrhea? [pause. Agree with all correct answers]

2. (Record first reason given for getting diarrhea): _____ RECORD
FIRST RESPONSE GIVEN IN SPACE ABOVE.

- [-----] (a) DRINK DIRTY WATER
- [-----] (b) DON’T WASH HANDS
- [-----] (c) DON’T WASH FOOD/EAT DIRTY FOOD
- [-----] (d) DON’T KEEP COMPOUND CLEAN
- [-----] (e) DON’T WASH DISHES
- [-----] (f) WASH WITH DIRTY WATER
- [-----] (g) WASH WITH DIRTY WATER
- [-----] (h) OTHER (SPECIFY): _____

INTERVIEWER SAYS: I would like to spend a few minutes to talk to you about water and sickness and to describe to you a product that can make your household's drinking water safe to drink. I will answer any questions that you have about the product that I will now describe. This should not take a long time.

I would like to first talk with you about some of the sicknesses that water can cause, and then later to give you some information about a solution that can help to prevent some of these sicknesses.

One particular illness, diarrhea, is particularly linked to bad water. Did you know that?

- One of the leading causes of diarrhea is drinking, washing with, or bathing in contaminated water.

Have you had diarrhea before?

Do you know anyone who has died from diarrhea, or anyone whose child has died from diarrhea?

It may seem uncommon, but around 35,000 children under 5 years of age died from diarrhea last year in Kenya. More than a million children died worldwide from diarrhea last year.

Repeated diarrhoea can also make it harder for young children to grow up strong and healthy.

This is very sad because we know how to prevent and treat diarrhea.

How do you treat it?

(IF THEY MENTION ORS): Oral Rehydration Solution (ORS), that's right.

(IF THEY DO NOT MENTION ORS): explain ORS and how to use it.

3.): _____ CHECK 1=YES, 2=NO

But it can be easier and less painful to **prevent** diarrhea than to treat it. One way to prevent diarrhea is to make sure your family drinks clean water.

Clean water is not always easy to recognize. Here are a few things you may not know on what makes water clean:

- Even if water looks and tastes clean, it may still be dirty because of little disease germs we can't see with our eyes.
- Even if the water is clean when it is collected or purchased, it may be contaminated by the time people drink it. This can happen if little disease germs that we cannot see with our eyes get in the water, while it is stored in the home. This happens when adults or children touch drinking water, often in the process of retrieving water.
- We should avoid touching water that will be used for drinking.

Ways to Purify Water

To have safe, clean water what can we do?

[Listen to answers.]

4.): _____ RECORD ANSWERS GIVEN.

[-----] (a) USE WATERGUARD

[-----] (b) BOIL DRINKING WATER

[-----] (c) FILTER WATER

[-----] (d) USE PUR

[-----] (e) USE ALUMINUM SULPHATE

[-----] (f) USE KLORINE

[-----] (g) USE AQUATABS

- [-----] (h) USE AQUAGUARD
- [-----] (i) USE CHLORINE DISPENSER
- [-----] (j) FILTER THROUGH A CLOTH
- [-----] (k) LET WATER SET
- [-----] (l) OTHER (SPECIFY): _____

Let me got though the answers you gave
 [Review only the answers below that they give.]

Filter through a cloth (not safe)

- You can filter water with a cloth to make water clear, it does not make it clean and safe. Most of the dangerous germs from the crap are very small and go through the cloth easily.
- Even worse, the cloth gets dirty, so it often *adds* germs to the water!
- This method is *not safe*.

Let water set (not safe)

Letting water set lets dust settle to the bottom. But *lots* of germs from the crap remains floating in the water. This method is *not safe*.

Boiling Water (safe)

Boiling is a great way to kill the dangerous germs in your water – as long as you boil *all* the water you drink and never touch the water.

But many people do not always boil because:

- Takes too much time boiling and cooling the water
 - Sometimes people just heat the water, without making it boil for a few minutes. That just warms the germs, without killing them.
- Even after boiling, we have to filter with a cloth or let the water settle to get rid of dust.
- Many times the cooking burner is busy. Sometimes there is no gas to boil.
- Boiled water doesn't have good taste
- Hot water can burn children

How many of you use a scoop to get water out of the jar? Unfortunately, even after you boil water, when dirty hands touch the water, it becomes contaminated again.

Chlorine (safe)

Chlorine is another good way to kill all the dangerous germs in your water.

But many people do not like chlorine because it changes the water's taste and smell.

Filter (Safe – read this section to all households whether or not they mentioned filtering as a method of making water safe)

This is the product I am here to talk to you about today

(If have a filter present, set it up as you speak. Show how it will be used. If no filter present, show pamphlets and marketing materials of Cera Maji filter as you speak.)

The filter is the most popular way to make the water clean because:

- It is easy to use
- It makes water clear and removes contamination
- It does not take much of your time because you just pour water in the top and let it be
- It doesn't change the taste of our water
- It includes safe storage with this pot
- You can draw the water through the tap, which prevents hands from touching the water
- It looks very nice

Using one of these filters alone will remove nearly all dangers from the water.

- There are a few tiny germs that sometimes make it through. So to have absolutely safest system, you could put boiled water in the top of the filter.
- But whether you boil or not, using the filter will make your water *much* safer.

Financial Burden of Filter

Many people do not buy filters only because they believe the filter is too expensive.

Most people forget that diseases are also expensive. They cause us to...

- Take time off work, lose income
- Pay for hospital bills

How much do you think it costs to have a kid in the hospital for diarrhea? Make sure you include the cost of transport to the hospital, the work you will miss, the cost of the drugs you will have to buy, and all the other expenses!

If the filter were used regularly, then these problems would be less common, and families could save money!

Review

So let's review.

- You know children who have been ill with diarrhea?
- You understand how water becomes contaminated?
- You think it is a bad idea to drink contaminated water?

- Then clearly this water filter is a great opportunity for you. It addresses the problems you have mentioned. And it is full of new and improved features!
- Millions of people use water filters to get pure and safe water.
- I am sure someone of your experience can see the many benefits of the water filter!

[READ THE FOLLOWING ONLY TO NOVEL SALES OFFER HOUSEHOLDS]:

At the same time, I am sure someone of your experience knows that sometimes salespeople over-promise.

- You do not trust everything someone says, do you?
- You like to see things with your own eyes, right?

Well, that is great! Because today I have a special offer for you! This offer is only in select neighborhoods in [this town] and it is only offered today. This special offer is for a **free trial** of this filter for **two weeks!** Free trial means you pay *nothing!*

I will text you in a week asking how you like the filter. If you do not like it, just reply asking me to come pick it up.

If you *do* like the filter, you might be worried, “How can I afford such a nice product?” Well, do not worry! This filter costs 1400 Ksh, but you are allowed to pay in installments via M-PESA over the course of two months! That is, after the two week free trial, if you decide to keep the filter, we can set up a personalized payment plan for you to pay for the filter in two months’ time. I will text you in advance of each scheduled payment to remind you of your payment due, and you can use M-PESA to send the money. You do not have to pay the M-PESA transfer fees either – those are included in this price!

If you ever do not like the filter, just text back and we will come pick it up. You will owe no more money after you return the filter.

Would you like to accept the free trial of this filter? Remember, it costs you *nothing* to enjoy a free trial!

- 5A. Record if free trial accepted: _____ (yes/no)
5B. Record mobile phone number associated with M-Pesa account: _____
6. Filter client name: _____
7. Compound name: _____
8. Nick name/landmark: _____
9. Village name: _____
10. Traditional sales offer: _____
11. Novel sales offer: _____
12. Reason why not accepted (if not accepted): _____
a. Filter is expensive
b. Filter is small
c. Filter is delicate
d. Don’t like study
e. Not home during visit
f. Other (SPECIFY): _____

FOR THOSE RESPONDENTS WHO ACCEPT NOVEL SALES OFFER (THIS CONTRACT APPEARED ON SWAP OFFICIAL LETTER HEAD)

MPOT Payment Contract Form

Today's date (dd/mm/yyyy): _____

I, _____ (customer name), willingly accept the offer of a free product trial for the CeraMaji filter from the Safe Water and AIDS Project (SWAP) and its representative, _____ (insert CHP name here). As a part of this agreement, I hereby acknowledge the following terms of this contract (both customer and SWAP CHP should initial each point of this contract below).

1. I agree that the date of my free trial to begin is : _____ (insert start date of free trial in dd/mm/yyyy format for date that filter will be delivered). Customer initials here: _____.
 2. I agree that my free trial will end on: _____ (insert end date of free trial that is two weeks after start date in #1 above, write in dd/mm/yyyy format). Customer initials here: _____.
 3. I agree that at the end of my free trial, if I elect to keep the CeraMaji filter, I will make a first payment in the amount of _____ Ksh (fill in amount of first payment) on the date my free trial ends specified in #2 above. Customer initials here: _____.
 4. After this initial payment, I agree to pay a total of 1400 Ksh to SWAP within a period of two months from the date that my free trial with the filter ends, which is the effective end of this contract. This means I will pay a total of 1400 Ksh by _____ (insert end date of contract in dd/mm/yyyy format, which is two months from date in #2 above).
 5. To meet my contractual obligation, I promise to make regular payments according to the following plan I have selected. I will make payments in the amount of _____ Ksh every _____ (insert or circle frequency of payments: daily/weekly/biweekly/monthly), for a total of _____ payments.
- (CHP: ENSURE THE PAYMENT PLAN ESTABLISHED TOTALS 1400 KSH).

I hereby sign my agreement of this contract.

(signature/markings of customer)

(signature of CHP)