SOCIAL SIGNALING AND CHILDHOOD IMMUNIZATION: A FIELD EXPERIMENT IN SIERRA LEONE

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Abstract

This paper explores the use of social signaling as a policy tool to sustainably affect childhood immunization. In a 26-month field experiment with public clinics in Sierra Leone, I introduce a verifiable signal - in the form of color-coded bracelets - given to children upon timely completion of the first four, or all five required vaccinations. Signals increase parents' belief in the visibility of their actions and their knowledge of other children's vaccine status. The impact of signals varies significantly with the cost and perceived benefits of the action: there are no discernible effects on timely and complete immunization when the signal is linked to an easier-to-complete vaccine with low perceived benefits, and large, positive effects when the signal is linked to a costlier-to-achieve vaccine with high perceived benefits. Parents adjust their behavior nine months prior to realizing the social image benefit, demonstrating the motivational strength of signaling incentives. Of substantive policy importance, bracelets increase full immunization at one year of age by 9 percentage points, with impacts persisting up to two years. At a cost of US$24.7 per additional fully immunized child, social signals can prove more cost-effective than financial or in-kind incentives.

Keywords: social signaling, social image, incentives, immunization
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I Introduction

Humans make choices within a social context and care about the consequences of these choices for their social image. Leveraging social image concerns provides a promising avenue for public economics, one that is particularly relevant in low-resource settings, where formal enforcement and implementation of material rewards are administratively and financially challenging.

In this paper, I partner with the Ministry of Health and Sanitation of Sierra Leone to implement a large-scale field experiment that increases the social image returns to childhood vaccinations. I take advantage of the fact that, while vaccinating a child at some point may not be particularly costly, completing a series of vaccinations each in a timely manner can be. Specifically, I introduce a new and verifiable signal - in the form of color-coded bracelets - which allows parents to show to others that they vaccinated their child in a timely manner, that is, within 2.5 months of each vaccine's due date.[1] I further vary how difficult it is to obtain the signal by linking it to two different vaccine targets: one that is easier to reach, the timely completion of all vaccines up until the fourth (due at 3.5 months of age); and one that is harder to reach, the timely completion of all vaccines up until the fifth and last vaccine (due at 9 months). The fourth vaccine marks the completion of the diphtheria, tetanus, and pertussis (DTP) series, while the fifth vaccine is the first dose of the measles vaccine. I use the experiment to answer two questions: How does the introduction of a signaling incentive affect behavior in a real-life setting, where individuals make decisions over a long time horizon? How do the effects of signals change when the cost and perceived benefits of the action vary, and why?

The context of childhood vaccination in Sierra Leone is well-suited to examine the potential of social image concerns to induce socially desirable behavior. First, there are strong social norms surrounding the importance of vaccination—79% of communities in my sample believe that parents who fail to vaccinate their children are negligent.[2] Second, whether a parent vaccinates their child in a timely manner is currently imperfectly observable, meaning there is scope to improve observability. Third, childhood immunization is one of the most cost-effective ways of reducing under-five mortality and averts 2-3 million deaths every year from diseases such as diphtheria, pertussis, and measles (UNICEF 2019).[3] Timely vaccination is crucial as the risk of infection and death from diseases is highest in children under the age of one (CDC 2022). Despite improvements in the availability and reliability of immunization services (UNICEF and WHO 2016), only

[1] This timeliness threshold is informed by WHO guidelines (WHO 2018) and the availability of immunization services at clinics.

[2] During the baseline survey, community members in a group were asked about the barriers parents face in immunizing their children. Surveyors recorded the three most commonly named reasons.

[3] Vaccines also contribute to higher educational outcomes and reduced poverty (van der Putten et al. 2015; Verguet et al. 2013). It is estimated that for every US$1 invested in immunization programs, a minimum of US$16 is generated in net health and economic benefits (Ozawa et al. 2016).

56% of children complete the first-year series of vaccinations, and a significant number are vaccinated late (Sierra Leone DHS 2020). This pattern is common in many low-income countries, and a large public health literature documents that insufficient demand, arising from parents forgetting appointments, a lack of awareness about the benefits from vaccination, and procrastination, explains the low take-up.[4,5]

Building on this, I design a field experiment that is grounded in the theory of social signaling, which posits that individuals' utility depends on the expectations that others form about their type based on their actions (Bénabou and Tirole 2006, 2011). My design leverages two features of childhood immunization. First, individuals have to take multiple actions, as children require five vaccinations before the age of one. Using this feature, I investigate how placing the signal at different points in the vaccine schedule affects parents' behavior. A significant number of parents fail to achieve timely vaccination for four and five vaccines, making these the relevant margins for increasing visibility. It is unclear ex-ante which signal is more effective. Completing five vaccines on time, an action achieved by only 57% of parents, sends a strong positive signal of being a "caring" parent, potentially providing significant motivation. However, if seen as too difficult, it will fail to motivate. Conversely, completing the first four vaccines in a timely manner, an action achieved by 74% of parents, is easier; thus, failing to do so sends a strong negative signal of being "negligent", which could in turn be highly motivating. From a policy standpoint, by introducing a signal at the fourth or fifth vaccine, my study tests whether social image concerns can be leveraged to achieve the last-mile of vaccine adoption and encourage take-up for harder to complete vaccines.

Second, vaccination decisions take place over a long time horizon, from the first vaccination at birth to the last at nine months of age (WHO 2018). Theory predicts that parents will complete earlier vaccines in a timely manner if the value of future signaling is sufficiently large. This supports the argument of placing the signal later in the schedule.

To study these predictions, I experimentally vary the information that bracelets provide about the number of vaccines a child has completed on time. I randomly assign 120 clinics and their entire catchment area to either one of three bracelet treatments or a control group where no bracelets are handed out.[6] This high level of randomization mitigates the risk of contamination and ensures a common understanding of the signals within a certain geographic area. In each of the first two bracelet treatments—hereafter Signal at 4 and Signal at 5 - children receive a yellow bracelet upon their first vaccination. In the Signal at 4 treatment, the yellow bracelet is exchanged for a green bracelet once a child completes all of the first four vaccines in a timely manner. In clinics assigned to the Signal

[4]This is evidenced by the results of a large number of studies testing the effectiveness of reminders (Eze et al. 2021) and conditional incentives (Ranganathan and Lagarde 2012) on vaccine uptake.

[5]E.g., in India (India DHS 2020), Peru (Peru DHS 2015), and Indonesia (Indonesia DHS 2017), 98, 91, and 91% of children respectively begin vaccinations, but only 78, 62, and 65% complete the full series.

[6]There is a total of 1,221 public clinics in Sierra Leone. The experiment covers 10% of these clinics.

at 5 treatment, the nurse exchanges the yellow bracelet for a green bracelet once a child completes all five vaccinations in a timely manner. In the third bracelet treatment, the Uninformative Bracelet, parents choose a yellow or green bracelet at the first vaccine, and the child keeps the same bracelet color for all subsequent vaccinations. The Uninformative Bracelet arm allows me to separate the signaling role from consumption, salience and reminder benefits of a bracelet.

Using an endline survey of 1,314 parents on knowledge, first- and second-order beliefs, I show that there are large information asymmetries in knowledge and parents know these exist: Control Group parents believe that only 48% of other parents have knowledge about their own child's vaccinations. Signaling bracelets increase parents' beliefs in the visibility of their actions by 27 and 35% (p=0.013 and p=0.026), respectively, compared to the Control Group. Furthermore, bracelets enhance parents' knowledge of other children's vaccinations: a child having a green bracelet increases the likelihood of other parents correctly knowing the number of vaccines the child has received by 18 and 37% in Signal at 4 and Signal at 5 (p=0.097 and p=0.021), respectively, compared to the Uninformative Bracelet. Yet, parents find it harder to update negatively when an older child has a yellow bracelet in both Signal at 4 and Signal at 5 communities. I hypothesize that this asymmetry in learning is due to parents needing to know a child's age and vaccine due date to recognize the yellow bracelet as a negative signal, making it a more difficult signal to learn from.

Next, I find that signaling bracelets increase timely vaccination, using two rounds of survey data for 4,897 children. Compared to the Control Group, signaling treatments combined lead to an increase in timely vaccination rates for four vaccines, from 74 to 80% (p=0.069), and for five vaccines, from 57 to 63% (p=0.082). The average effects mask substantial heterogeneity by treatment: Signal at 4 has a small, insignificant effect on the share of children receiving timely vaccinations for four vaccines (2 percentage points, p=0.58), and has no impact on the timely completion of five vaccines. In contrast, Signal at 5 has a large effect on the share of children receiving timely vaccinations for five vaccines (13.3 percentage points, p=0.001). This effect remains large and significant (10.5 percentage points, p=0.004) when comparing Signal at 5 to the Uninformative Bracelet, suggesting social signaling is the primary mechanism.

Signal at 5 also significantly increases the share of children receiving timely vaccinations earlier in the schedule. For instance, the percentage of children receiving four timely vaccinations rises by 10.3 percentage points (p=0.002) compared to the Control Group. This pattern of treatment effects is consistent with parents placing a high value on future signaling. This finding also suggests that bracelets are not simply acting as vaccine-specific reminders.

Why was Signal at 5 effective, while Signal at 4 was not? Both signals were equally effective in increasing the visibility of vaccinations and changing parents' beliefs. Further, there was scope to increase the timely take-up of vaccine four in Signal at 4, as evidenced by the strong treatments effects in Signal at 5. Survey data shows higher bracelet retention among children in Signal at 5 compared to Signal at 4, suggesting instead that parents place a higher value on signaling the timely completion of five vaccines. I find two plausible explanations for this difference in valuation. First, Signal at 5 was seen as a more informative signal about a parent's type due to an asymmetry in learning: community members found it hard to learn from the negative signal of failing to get a green bracelet. Alternatively, parents may assign greater importance to the fifth vaccine than the fourth, thus thinking more highly of parents who completed all five vaccines on time. Note that there is no evidence indicating that bracelets changed vaccine preferences.

Because timely vaccination is particularly costly and thus may reveal type more effectively, the experiment was designed to focus on timely vaccination. However, policy makers might care about vaccine completion, independent of timeliness, and to what extent treatment effects are lasting. I find that Signal at 5 significantly increases the completion of later vaccines by 12 months: from 92 to 95% (p=0.031) for vaccine four and from 69 to 78% (p=0.002) for vaccine five, compared to the Control Group. Treatment effects remain significant when compared to the Uninformative Bracelet and Signal at 4, neither of which impacted the number of vaccinations at 12 months of age. Signal at 5's impact partially persists at 18 and 24 months. Compared to the Control Group, there is an increase of 2.1 and 6.1 percentage points (p=0.114 and p=0.041) for vaccine rates for four and five, respectively, at 18 months, and increases of 2.3 and 5.1 percentage points (p=0.076 and p=0.086), at 24 months. Effect sizes remain between 2 to 5 percentage points when compared to the Uninformative treatment, but I am only powered to detect such differences for vaccine four (p=0.094 and p=0.047).

Taken together, these findings are of substantive policy importance: a signaling incentive that allows parents to broadcast a costly action beneficial for their child's health increases timely and complete vaccination to levels necessary for herd immunity. At a cost of US$24.7 per additional fully immunized child, bracelets prove comparable to the most cost-effective interventions (Banerjee et al. 2021; Chandir et al. 2022) and can be more effective than financial and in-kind incentives (Banerjee et al. 2010; Gibson et al. 2017).

This paper makes four contributions. First, to my knowledge, this is the first field experiment designed to investigate social signaling in a setting where individuals take multiple high-stakes actions over a long period of time. Existing studies show that individuals are willing to incur considerable costs when faced with the decision to take an immediate action that allows them to signal their type to others (Bursztyn et al. 2017; Friedrichsen et al. 2018; Soetevent 2005). This raises the question whether these responses are strategic, reflecting deliberate choices, or whether they are driven by emotions. Breza and Chandrasekhar (2019) show that individuals save more when their progress is shared with others and find suggestive evidence this is partly driven by reputational concerns. My study is designed to isolate social image concerns. It shows that these can act like economic incentives, encouraging forward-looking behavior and health investments.

Second, this study contributes to a nascent literature on field experiments examining social image concerns and how these can be shaped to motivate desirable behavior (Breza and Chandrasekhar 2019; Bursztyn et al. 2018, 2017; Bursztyn and Jensen 2017; Chandrasekhar et al. 2018; Karing et al. 2023). The experimental design moves beyond manipulating the visibility of actions (Ashraf et al. 2014; DellaVigna et al. 2016; Karlan and McConnell 2014; Kessler 2017; Perez-Truglia and Cruces 2017) by introducing multiple signals tied to different actions. This can be applied to many other settings, such as prenatal care visits or Covid-19 vaccinations. The results demonstrate that social image effects can vary significantly with the costs and benefits of actions, pointing to an important mechanism. Negative signals are more likely to be disregarded due to their ambiguity about whether a person chose not to act or did not have the opportunity, whereas positive signals clearly convey that an action was taken. As a result, signals might largely work through social rewards.

Third, this paper provides the first experimental evidence on social signaling in health and contributes to a literature on incentives to increase the use of health services and public goods in low-income settings (Ahmed et al. 2022; Ashraf et al. 2014; Sato and Takasaki 2017; Thornton 2008). A number of studies have found large effects of financial (Banerjee et al. 2021; Chandir et al. 2022; Gibson et al. 2017; Seth et al. 2018; Ranganathan and Lagarde 2012) and consumption incentives (Banerjee et al. 2010; Chandir et al. 2010) on vaccination take-up. In contrast, my study focuses on an incentive that relies on social recognition.

Fourth, the findings of this study have the potential to inform policy strategies to increase vaccination demand. Current immunization programs heavily rely on health campaigns and outreach efforts to address the "last-mile problem" of reaching immunization targets. This research demonstrates that social signals can cost-effectively motivate parents to travel further for vaccinations, including for those with already high take-up rates. This is crucial for governments balancing central clinic services with outreach to remote areas. Moreover, signaling incentives could help reverse Covid-19-induced delays in vaccination (Shet et al. 2022; WHO 2023) and accelerate the uptake of new vaccines, such as the malaria vaccine (UNICEF 2022). For parents who are uncertain about the risks or availability of vaccines, bracelets can signal both safety and vaccine accessibility.

The remainder of this paper is organized as follows. Section II provides an overview of the empirical setting. Section III describes the experimental design and its implementation. Section IV through Section VI discusses the experimental results. Section VII reports on the cost-effectiveness of the intervention. Section VIII concludes.

II Context

II.A Childhood Immunization

A child under the age of one needs to receive five routine vaccinations. The first vaccine is due after birth, followed by a three-dose series of DTP vaccines protecting against diphtheria, tetanus, and pertussis. The three doses must be given one month apart, with the first given at 1.5 months and the last dose given at 3.5 months of age. The fourth vaccine therefore follows a series of closely spaced reminders to vaccinate and is due at a time when a child's health is at the forefront of parents' minds. The fifth vaccine is the first of a two-dose series protecting against measles and is due at nine months of age (WHO 2018).[7] Parents are more likely to miss the vaccine for two reasons. Firstly, the vaccine is scheduled six months after the fourth dose, making it harder to remember. Secondly, qualitative feedback from focus groups suggests that as children grow older and appear physically stronger, mothers perceive less urgency in visiting the clinic. For most children, the first two doses of DTP are sufficient to obtain protection against the diseases.[8] The first dose of measles, however, is essential for children to be protected against the disease. There is no required spacing between vaccines one and two, or between four and five. A child can be late for DPT3 and not complete the series on time, but still receive their first measles vaccine on schedule. Empirically, the share of children vaccinated on time for vaccine five (66.3% in the Control Group, Table B16) is therefore higher than the share of children who also received all previous vaccinations on time (56.7% in the Control Group, Table IV).

II.B The Importance of Timely Immunization

Despite increasingly high coverage rates in many low- and middle-income countries, a significant share of children are not fully protected for several months, up to a year after their due date, due to delays in vaccination. In other words, vaccinating children on time is hard, which leads parents to postpone vaccinations to a later point. To counter these delays, governments conduct resource-intensive outreach campaigns (EPI 2014). The Covid-19 pandemic further amplified this challenge as it caused major setbacks in vaccination coverage globally: 25 million children under one did not complete all basic vaccinations in 2021, the highest number since 2009 (WHO 2023).

Timely vaccination is a desirable health outcome, as the risk of disease infection and

[7] The study does not consider the second measles dose, due at 15 months. It was introduced in Sierra Leone just before the experiment started, had not yet been added to vaccination cards, and nurses were still adjusting to administering it.

[8] The antibody level increases after the second dose of diphtheria toxoid and is much higher after the third dose; while most children have a base level of protection from the first two doses of DTP, the third dose is necessary for 94-100 percent of children to have protective antibody levels > 0.01 IU/mL and reach herd immunity thresholds (WHO 2017).

death is the highest in younger children, and early vaccination ensures that children receive regular and frequent check-ups for other health issues.[9] Yet, most public health studies focus on coverage, with limited evidence on interventions that can improve timeliness (Engelbert et al. 2022). SMS reminders have proven effective in improving timely vaccination (Eze et al. 2021), but require reliable mobile phone and network access, thereby excluding some of the poorest households.

II.C Low-Income Country Context of Sierra Leone

Sierra Leone is one of the poorest countries in the world, ranking 181 out of 188 in the Human Development Index (UNDP 2016). Women are the primary caregivers of children, taking them for vaccinations. About half of mothers (47%) in my study sample have no education, 31% have some primary education, and only 22% have any secondary education. Seventy-three percent of mothers are engaged in farm work, and fewer than 12% possess a mobile phone (Appendix Table B1).

The country has one of the highest infant and under-five mortality rates, with 75 and 134 deaths per 1,000 live births, respectively (Sierra Leone DHS 2020). Childhood immunization is one of the most cost-effective ways to reduce child mortality, and increasing timely and complete immunization in a country like Sierra Leone can have a particularly large impact. One third of all under-five diarrheal disease hospitalizations are caused by rotavirus, which can be prevented by an additional vaccine during the DTP series (PATH 2017). Furthermore, vaccination visits provide an opportunity to record children's weight, height, and overall development, making them the main point of contact for monitoring newborns' health and detecting health problems such as malnutrition.

Vaccines are free of charge and readily available. At baseline, fewer than 14% of clinics in my study sample reported having a stock-out of one or more vaccines (Appendix Table B2, Panel A). Immunization services are offered on a fixed schedule, either weekly (66% of sample) or monthly (34%). The functionality of the supply side is reflected in communities' perceptions: 79% name negligence of parents as one of the three most common reasons for delayed or missed vaccination (Appendix Table B2, Panel B). Sixty-five percent and 42% of communities reported lack of knowledge of the benefits of vaccines and distance to clinics, respectively.

Importantly, childhood vaccination is a well-known health behavior: 94% of communities at baseline know that children need five vaccinations and are aware of its importance for health.[10] Finally, vaccination reminders exist in this context: nurses write a child's

[9] Delays in vaccination put infants and young children at the highest risk of falling ill and dying from diseases: one out of five children who contract diphtheria under the age of 5 dies (WHO 2017), and pertussis predominantly affects children younger than 12 months (CDC 2022).

[10] Individual surveys corroborate this finding: 96% of mothers attending vaccinations, who were randomly sampled for short surveys during their clinic visit, were aware that children under the age of one require five vaccinations.

next vaccine due date on their vaccination card and regularly remind parents about upcoming vaccination days (e.g. through community health workers). In my sample, 95% of children have a vaccine card (Appendix Table B3, Panel B).

III Experimental Design

III.A Experimental Treatments: Bracelets as Signals

In partnership with the Ministry of Health of Sierra Leone, I increase the visibility of parents' vaccination decisions by introducing color-coded bracelets as signals. Health workers give the bracelets to children upon vaccination at public clinics. In some instances, bracelets are contingent upon the timely completion of an earlier vaccine, while in others, they depend on the last vaccine in the schedule. The conceptual framework underpinning the experimental design is detailed in Appendix D.

The bracelets create an opportunity for parents to publicly show that they correctly vaccinated their child. Figure I displays the specific bracelet treatments that health workers implement at each of the five vaccinations. I randomize the assignment of clinics to one of three distinct bracelet treatments and one control group:

Control Group: Children do not receive any bracelets at vaccinations.

Signal at 4: Children receive a yellow "1st visit" bracelet when coming for the first vaccine. Children keep the same bracelet for vaccines two and three. If a child comes on time for all vaccines up to vaccine four (by age six months), health workers exchange the yellow bracelet for a green "4th visit" bracelet. If a child comes late, the bracelet is exchanged for an identical yellow "1st visit" bracelet. At vaccine five, irrespective of timeliness, the bracelet is exchanged for a new bracelet that is identical to the last bracelet the child had received.

Signal at 5: Children receive a yellow "1st visit" bracelet when coming for the first vaccine. Children keep the same bracelet for vaccines two and three, and the bracelet is exchanged for an identical yellow "1st visit" bracelet at vaccine four. If a child comes on time for all vaccines up to vaccine five (by age 11 months), health workers exchange the yellow bracelet for a green "5th visit" bracelet. If a child comes late, the bracelet is exchanged for an identical yellow "1st visit" bracelet.

Uninformative Bracelet: Parents choose a green or yellow "1st visit" bracelet when coming for the first vaccine. Children keep the same bracelet for vaccines two and three. At vaccines four and five the bracelet is exchanged for a new identical "1st visit" bracelet of the originally chosen color.

In all three bracelet treatments actions are grouped into two signals. In Signal at

4, others can only tell whether a child was vaccinated in a timely manner for four or more vaccines. In Signal at 5, the bracelets show if a child received all five vaccines on time. The Uninformative Bracelet shows that a child started vaccination but provides no information about the (timely) completion of later vaccines. While children who are late for earlier vaccines can still receive the fifth vaccine on time, the signal's conditionality was designed to incentivize parents to also complete prior vaccinations in a timely manner. This feature of the design allows me to test whether individuals act strategically by making decisions several months in advance of receiving the signal.

Appendix Figure A1 displays the actual bracelets that were distributed at clinics. All bracelets were made from silicone and size-adjustable so they could comfortably fit the wrist of a child between the ages of zero and 12 months. The latter was key for the experimental design as i) it made the bracelet a *durable* signal, visible to others and allowing for comparisons beyond the time of the vaccination, and ii) it ensured that the bracelet's size would not inadvertently reveal the number of vaccinations a child has completed.[11] Over the course of the experiment, health workers distributed a total of 36,000 bracelets. Children born before the start of the experiment, who had already started the vaccination schedule, received their first bracelet at their next vaccination. Appendix Figures F1, F2, F3 and F4 show the messages clinic staff were trained to give to mothers when handing out or exchanging bracelets. Each clinic was given a laminated hard copy of the messaging card.

III.B Identifying Effects

The combined effect of increased salience (e.g., reminder effects), consumption utility, social learning, normative influence, and social image concerns is captured by comparing the share of children vaccinated on time for four and five vaccines in the Control Group with those in Signals at 4 and 5. This analysis assesses the effectiveness of bracelets as a policy tool.

The comparison of Signal at 4 and Signal at 5 with the Uninformative Bracelet for vaccines four and five isolates the effect of social signaling preferences on vaccination decisions. In all three signaling treatments, bracelet handouts and exchanges occur at the same vaccines to hold constant any additional consumption utility of bracelets. By distributing bracelets and using the colors green and yellow in all three signaling treatments, I further hold constant salience and reminder effects that are due to (1) the general visibility of vaccinations through bracelets, and (2) the introduction of new colors over time. In other words, the only difference remaining is what actions can be signaled, that is, the timely completion of a specific set of vaccines. If the green bracelets in Signal at 4 and

[11] As a child's wrist grows, a snug or ill-fitting bracelet could indicate the child's vaccination status, even if the bracelet's color remained unchanged.

Signal at 5 treatments acted as vaccine-specific reminders for vaccines four and five, we would expect to see a significant increase in the share of children taking these vaccines on time. However, we would not expect to see increases in the timely completion of earlier vaccinations. An increase in the share of children who complete vaccines one, two, or three on time in Signal at 4, and vaccine four in Signal at 5, demonstrates that individuals respond to the future value of signaling and alter their behavior in anticipation of it.

A larger increase in the share of children vaccinated on time for four vaccines in Signal at 5 compared to Signal at 4 suggests that parents assign a higher value to the Signal at 5 bracelet. This difference in value might stem from varied perceptions about the importance of completing the fourth versus fifth vaccine on time, or the degree to which timely completion is a prevalent behavior, where failing to do so might result in stigma and completing it could lead to praise. Both factors can influence how individuals learn from signals about types. The experimental design cannot distinguish between these factors. To assess their relevance, I collect survey data on individuals' beliefs about the importance of different vaccines and others' judgments, and look at observed differences in uptake between the fourth and fifth vaccines.

Finally, I can quantify the extent to which treatment effects are driven by social learning. By design, parents in the Signal at 4 treatment have no signaling incentive to complete vaccine five on time since green bracelets do not distinguish parents who took their child for four vaccines and those who went for all five vaccinations. An increase in the share of children vaccinated on time for vaccine five could arise from two reasons: (i) if uncertainty plays an important role, some parents who now complete vaccine four on time in Signal at 4 receive a positive cost shock and thus also take vaccine five on time; (ii) parents may learn from observing bracelets about vaccination uptake in their community and update their beliefs about the benefits of vaccinations, thereby increasing their valuation of vaccine five. To differentiate (i), which still falls within the predictions of the signaling model, from (ii), an alternative behavioral mechanism, I can compute the transition probability between vaccines four and five. An increase in the transition probability in Signal at 4 relative to the Uninformative Bracelet would strongly suggest that learning is a relevant alternative mechanism.

To address concerns regarding learning about the importance of vaccine five in Signal at 5, I elicit individuals' beliefs about aggregate take-up of vaccines in their community and the importance of different vaccinations. I use these survey measures to test for differences across arms.

III.C Clinic Randomization and Community Selection

Treatment was randomized at the clinic level so that every child living in the catchment area of a clinic was eligible for the same bracelet treatment. In total, I selected 120 clinics across four of Sierra Leone's 14 districts to be part of the study. To randomly draw 120 clinics from the pool of 243 public clinics across the four districts, I used an acceptance-rejection method whereby I randomly picked clinics, checked their acceptability based on their overlap with already selected clinics, and if accepted, added them to the selected sample. This process was repeated until it had selected the requisite number of clinics. If no acceptable clinic remained before completion, the whole process was restarted. Each clinic had a 5 mile radius as catchment circle. A clinic was considered acceptable if its catchment circle did not leave any of the already selected clinics' non-overlapping catchment circle smaller than 35% of its area. Clinics were then randomly assigned, stratified over the four districts and two implementation waves, to the three different bracelet treatments and the Control Group.[12] Appendix Figure A2 shows the geographic span of the experiment across the four districts and the final selection of clinics. At the start of the study, surveyors selected - using in-field randomization - two communities at close distance (0 to 2 miles) and three communities at far distance (2 to 5 miles), from the pre-specified non-overlapping catchment area of each clinic.

In Appendix Figure A3, the upper map shows the non-overlapping clinic catchment areas. The lower map provides an example map from one of these clinic areas, that surveyors used for in-field community selection. In total, the experiment included 597 communities. I excluded one clinic in the urban part of Western Area Rural from the analysis as the research implementation was seriously impeded by clinic staff turn-over, community relocations, and deficiencies in monitoring and data collection by a surveyor.

III.D Information Treatment

While such a high level of randomization significantly increased the logistical demands of the experiment, it was key to reducing the risk of incorrect implementation by health workers, and to creating a common understanding of the meaning of the bracelets.

At the start of the experiment, surveyors visited 597 selected communities to hold information meetings. The objective was to highlight the health and economic benefits of timely and complete vaccinations, to discuss existing barriers, and in signaling treatments, to inform a wide range of community members about the bracelets and create common knowledge about their meaning (see Appendix Figures F5 and F6 for the scripts used at the information meetings). The average meeting attendance was 43 people, with almost all meetings being attended by a health representative, e.g. a community health worker (94%) and a community leader, e.g. chief (98% of meetings). Surveyors held a second information meeting in each community two to four months later, to reiterate the importance of vaccinations and explain the meaning of the bracelets, now that clinics

[12]The experiment was phased in in two waves: 44 clinics started implementation between mid-June and mid-July 2016 and 76 clinics started implementation between end of September and November 2016.

were handing them out.

III.E Experiment Timeline and Data

Below, I detail the timeline of the experiment implementation and the main data collection activities.

Jun ‘16 - Nov ‘16	**Start of the Experiment:** baseline clinic and community survey; training of 348 government health workers across 120 clinics in messaging to parents and implementation of bracelets; information meetings about the benefits of vaccination and meaning of bracelets in 597 communities including close to 25,000 adults.
Jul ‘16 - Aug ‘18	**Clinic implementation:** health workers hand out bracelets as part of regular monthly or weekly routine vaccination services at clinics.
Jul ‘16 - Jan ‘18	**Monitoring of implementation:** surveyors regularly visit clinics to verify the correct hand out and exchanges of bracelets, messages given to parents, and recording of vaccine visits; training of new clinic staff in implementation; digitization of administrative records; follow-up information meetings in communities.
Sep ‘17 - Jan ‘18	**Listing survey:** comprehensive listing of 14,061 children in 597 communities to collect immunization data.
Feb ‘18 - Apr ‘18	**Endline data collection:** in-depth surveying of 1,323 parents and collection of administrative clinic data.
Dec ‘20 - Jul ‘21	**Follow-up survey:** revisiting and surveying of 5,030 children.

I use several data sources for my analysis:

1) *Baseline clinic and community survey data:* surveys with nurses in charge of study clinics and community members who participated in information meetings. This data is used to check for balance on clinic and community characteristics across control and treatment groups, and for control variables.

2) *Listing survey data (first round):* surveys with parents capturing residence status, children's date of birth, vaccinations received and dates, ownership and wearing of bracelets. This data is used to verify the correct handout of bracelets by clinics, assess the accuracy of mothers' beliefs about other children's bracelets and vaccinations and estimate treatment effects on timely and complete vaccination.

3) *Follow-up survey data (second round):* surveys with parents of children who were less than one year old at the time of the original listing, capturing new vaccination outcomes. I use this data to increase the final outcome sample.[13]

4) *Endline data:* in-depth survey of a random sample of parents. This data is used to estimate treatment effects on first- and second-order beliefs about other children's

[13]The follow-up survey was delayed by one year due to the COVID-19 pandemic and its implementation took considerably longer due to restrictions in field work.

vaccinations, their bracelets and color, and preferences and knowledge about vaccinations. Appendix C details how endline respondents were sampled.

5) *Administrative clinic records:* digitized vaccination records from study clinics including vaccines received, date of vaccination, whether the child received a bracelet and its color. I use this data to verify the accuracy of mothers' beliefs about other children's vaccine status.

III.F Sample Definition and Randomization Checks

My main outcome was collected in two rounds: the listing survey and the follow-up survey. In the first round, I listed 14,061 children, of which 8,480 were eligible to be part of the study sample. Eligibility was defined by being born when the experiment was implemented and monitored, that is between July 2016 and December 2017; and attending one of the 119 study clinics for immunizations. I listed a larger number of children than those who were eligible to be included in the analysis to test for balance in vaccination outcomes prior to the experiment and to mitigate the risk of enumerators missing children who were born around the eligibility cut-off. I surveyed 1,857 eligible children who were 12 months or older at the time of the listing survey–meaning I observed their full vaccination history. In the second round, I re-surveyed 3,040 eligible children who were older than 12 months at the time of the follow-up survey, leading to a final analysis sample of 4,897 children (see Appendix Figure A4).

Appendix Table B3 Panel A describes the characteristics of my main analysis sample and shows that the success rate of re-surveying children ranges between 69 and 73%. There are several factors driving the sample attrition. A sizable share of children (17%) had moved at the time of the follow-up survey. The primary reasons for moving were economic opportunities (for 55%) and family or community conflict (for 30% of moved parents). The share of children moved increased between the listing and the follow-up survey since most children were younger than one year of age at the time of the listing survey and older than three years at follow-up. The probability of parents moving sharply increases once a child reaches one year of age or older, with only 3% of parents having moved when the child was younger than one year. It is extremely difficult to track moved children in this context since few parents have a phone (12%, see Table B1). Other reasons for attrition include parents traveling (5%) or the child being deceased (4%).[14] Importantly, the sample attrition is not due to a lack of enumerator effort as demonstrated by the small share of children who enumerators could not find (less than 3%).

There are some imbalances in attrition (Table B3). During the listing, the share of children who had moved was lower in Signal at 4 compared to the Uninformative Bracelet

[14] Field staff spent one to two weeks in each clinic area, meaning that the travel-related attrition accounts for parents away for relatively long time periods. I did not collect immunization data from parents of deceased children, as doing so is not recommended without a mental health professional.

and Signal at 5, which led to differences in sample size of 2 and 1.6%, respectively. The overall attrition rate is not significantly different across arms. The share of children who attrited in the Signal at 4 treatment remains lower during the follow-up survey, leading to small but significant differences in sample size of 3.5 and 5.7% compared to the Control Group and the Uninformative Bracelet, respectively. These differences are driven by fewer deceased and moved children.

Table B4 displays attrition and balance checks for the subsample of children included in the analysis of vaccination outcomes at 18 and 24 months of age. Since this long-run outcome is only observed for children who were surveyed during the follow-up survey, attrition rates are higher ($\sim$ 36-42%) and the imbalances that I observe for the full sample–between Signal at 4 and other groups–increase mechanically.

Importantly, I find no evidence that attrition or imbalances in attrition created a bias in treatment effects. In Appendix Table C1, I test for differences in vaccination behavior in response to treatments between children who attrited at follow-up and those I resurveyed. Specifically, I examine children's vaccination outcomes for vaccines one through four at the time of the listing, when I observed both groups of children. The results show no significant differences in treatment responses. However, children who were successfully followed-up have significantly better immunization outcomes than attrited children across all arms. In my main specification, to account for this, I include a vaccine-specific binary indicator controlling for the data source, that is, whether the vaccine information was obtained during the listing or the follow-up survey.

Appendix Tables B1, B2, and B3 report the randomization checks for the main analysis sample, the endline sample, and for the selected clinics and communities. Pairwise comparisons between control and treatment groups show that all study groups are well-balanced on key characteristics. Given the large number of comparisons, a few coefficients are statistically significant at the 10% (21 out of 378) and 5% (13 out of 378) levels. The F-tests for joint significance consistently yield p-values greater than 0.10 except for the share of children who moved at the time of the listing and follow-up. Notably, there are some differences in clinic population size and travel distance to clinics. Specifically, the Uninformative Bracelet group having on average 14 to 20% smaller clinic populations compared to Signal at 4 and 5 clinics, and 10 to 20% longer travel distances compared to Control and Signal at 5 clinics. These variables are controlled for in all analyses, so they should not affect the results.

Appendix Table B3 Panel C tests for differences in pre-trends in timely vaccination for vaccines one, two and three and I find no statistically significant differences. Appendix Table B1 shows that there are no significant differences in socio-demographic characteristics among endline respondents and that the elicitation of beliefs was equally well implemented across arms. Lastly, Appendix Table B2 confirms the consistent implementation of the experiment and surveys across arms.

III.G Compliance with Implementation Protocol

To verify whether health workers correctly handed out and exchanged bracelets, surveyors asked parents to report the bracelet color given to their child during vaccination and the number of vaccines the child had received by that time. Figure II displays the fraction of children in the Uninformative Bracelet, Signal at 4 and Signal at 5 that received a yellow, green, or no bracelet, conditional on the number of vaccines received. Almost every child had a bracelet (93.5%), with no significant differences across arms. In the Uninformative treatment, there is no significant correlation between the number of vaccines a child has received and the reported bracelet color (see Appendix Table B5, columns 5 and 6). It is evident that a majority of parents favor the color yellow over green, with 62.2 and 37.8% of parents choosing them, respectively.

In Signals at 4 and 5, there is a clear relationship between a child's bracelet color and the number of vaccinations they received. Specifically, there is a large increase-up to 61% for Signal at 4 and 70% for Signal at 5-in the proportion of children with a green bracelet at vaccines four and five, respectively. Children who received the fourth and/or fifth vaccine but had a yellow bracelet either came late for the vaccine or health workers missed to give the correct bracelet. Therefore, a yellow bracelet on an older child provides a noisy signal about the number of vaccines received. Conversely, nearly no child (1.8%) received a green bracelet before their fourth or fifth vaccine, respectively. Furthermore, 36.5% of children received a green bracelet when they came late for their vaccine (Appendix Figure A5). Thus, a green bracelet is a highly informative signal that a child has received their fourth or fifth vaccine, but it is less informative about timeliness. Finally, there is no significant difference in the share of incorrectly handed out bracelets between Signal at 4 and Signal at 5 treatments.

IV Beliefs: Do Individuals Update from Signals?

Bracelets aim to create an opportunity for parents to demonstrate that they care about their children's health. For this to work, parents must believe that others (1) will use the colors of bracelets to learn about their actions, and (2) will form expectations about their type conditional on their actions. In this section, I empirically verify these mechanisms.

IV.A Method

I first elicit parents' first- and second-order beliefs about vaccination decisions and their perceptions of others' types. At endline, each mother was asked about five other children in her community, randomly selected from those born since the start of the experiment. If a mother did not recognize a child's name, she was given a different name until she identified five children.[15] For each identified child, mothers were asked about their relationship with the child's mother, the number of vaccines the child had received, whether the child had a bracelet, its color, and the beliefs of the other mother regarding her own child's vaccine status and bracelet. First-order beliefs about other mothers' vaccination decisions were incentivized with a small reward for correct guesses about the number of vaccines. Second-order beliefs were not incentivized, as verifying the accuracy of answers would have required surveying all mothers in the community.

To measure perceptions, each mother was asked about others' concerns regarding her child's vaccination status and their perceptions of her based on her child's vaccine status. When analyzing perceptions, the sample remains constant, as these questions are not specific to a particular child and not tied to a specific age category. However, in the analysis of mothers' first and second-order beliefs, which focus on children born after the study started, the sample includes fewer older children. This results in fewer observations for later vaccines.

Second, I assess the accuracy of first-order beliefs about other children's vaccinations. I do so by linking respondents' answers with vaccine outcomes from the listing, endline and follow-up survey, or administrative clinic records.

IV.B Effect of Signals on Beliefs about Actions

IV.B.1 Assumptions: Visibility and Understanding of Bracelets

Bracelets are highly visible in all three bracelet treatments, as shown in Table I. For 91% of children, mothers can tell if the child has a bracelet, and for 87%, they can specify the bracelet's color.[16] Importantly, reported visibility is not driven by reverse inference. For the vast majority of children (95%), mothers report knowing the child has a particular color bracelet because they saw the bracelet on the child or the child receiving the bracelet at the clinic (Appendix Table B6).[17] In line with these first-order beliefs, mothers believe that 79% of other mothers know their child's bracelet color.

Parents effectively use bracelet colors to infer the number of vaccines children have received in signaling treatments. Panel A of Figure III shows the probabilities mothers assign to children having completed at least four or five vaccines, based on whether they have a yellow or green bracelet. The almost perfectly overlapping yellow and green bars

[15] On average, mothers were asked about 6.1 children and recognized 4.2 in control group clinics. Sixty-three percent of respondents recognized five children, while only 12% recognized fewer than three. In cases where fewer were recognized, communities were often smaller with fewer than five children in the relevant age range. There are no significant differences in the average number of children recognized or the number of children asked about across arms (see Appendix Table B1).

[16] Mothers assigned to treatments Signal at 4 or Signal at 5 are significantly more likely by 10.6 and 8.2 percentage points respectively (p<0.01 for both), to recall a child's bracelet color, likely due to greater attention being paid to color as it holds specific meaning.

[17] Only for 10% of children respondents state their knowledge is based on the child's vaccine count or the assumption that all children receive a bracelet.

in the Uninformative Bracelet demonstrate that–as intended–there are no systematic differences in mothers' guesses based on bracelet color.[18] In contrast, for Signal at 4 and Signal at 5, there are large and significant differences in the probabilities mothers assign. Mothers in Signal at 4 believe only 50% of children with a yellow bracelet have completed vaccine four, compared to 87% with a green bracelet - a 36 percentage points increase ($p<0.001$) relative to the Uninformative Bracelet. For Signal at 5, changes in beliefs about the completion of vaccine five are driven by the green bracelet and are muted for the yellow bracelet, showing a net increase of 29 percentage points ($p<0.001$) compared to the Uninformative Bracelet. Notably, mothers in Signal at 4 are also more likely to believe that a child completed vaccine five when the child is wearing a green bracelet (10 percentage points, $p<0.001$). Yet, this shift in beliefs is significantly less pronounced than in Signal at 5, accounting for only 42% of the effect observed in Signal at 5 ($p=0.049$).

Panel B of Figure III shows the actual probabilities of vaccine completion, confirming that mothers' beliefs are consistent with reality. Mothers assigned to treatments Signal at 4 or Signal at 5 correctly recognize that some children with a yellow bracelet came for vaccines four and five (either due to vaccinating late or implementation errors). The comparison also reveals that mothers do not fully adjust their beliefs in response to green bracelets: the probabilities mothers assign to a child having received the fourth vaccine in Signal at 4, and both the fourth and fifth vaccines in Signal at 5, should have been one.

IV.B.2 Beliefs Updating and Information Asymmetries

Mothers in the Control Group believe that at most 48% of other mothers in their community are aware of their child's vaccination status. Signaling bracelets increase mothers' beliefs regarding the visibility of their actions. Table II shows the influence of different bracelets on second-order beliefs relative to the Control Group. This is shown for children ages 3.5 to 9 months who are eligible for vaccine four but not yet due for vaccine five (column 1), and for children ages 9 to 12 months eligible for vaccine five (column 2). Mothers in Signal at 4 and Signal at 5 are respectively 13 ($p=0.01$) and 16.5 ($p=0.02$) percentage points more likely to believe that other mothers know about their child's fourth and fifth vaccinations. I find smaller and insignificant effects for the Uninformative Bracelet (8 and 5.8 percentage points, respectively), but standard errors are large and I am unable to detect significant differences compared to the signaling treatments ($p=0.29$ and $p=0.11$, respectively). The positive coefficients in the Uninformative treatment suggest that bracelets increase the salience of childhood immunization in general.

[18] The difference between the yellow and green bars for vaccine five in the Uninformative treatment is marginally significant at 10%. This difference can be explained by the actual vaccination outcomes displayed in Panel B: Truth of Figure III: there is a small difference in the likelihood of having completed vaccine five between children with yellow versus green bracelets.

Consistent with second-order beliefs, mothers in the Control Group possess accurate knowledge for at most 50% of children in their community. Signals at 4 and 5 both lead to improvements in knowledge compared to the Uninformative Bracelet (Table II, columns 3 and 4) with increases of 1.9 and 7.9 percentage points, respectively (p=0.65 and p=0.09).

The effects mask strong heterogeneity by bracelet color. Using the same sample as in Figure III, Table III reports treatment effects by yellow and green bracelets for Signal at 4 and Signal at 5, compared to the Uninformative Bracelet.[19] Signals at 4 and 5 lead to sizable improvements in correct knowledge for children with a green bracelet, with increases by 18 and 37% (p=0.10 and p=0.02), respectively. These effects are due to mothers being significantly less likely to underestimate children's number of vaccinations, with decreases of 9.9 (p=0.02) and 20.7 percentage points (p<0.001), respectively.[20] Conversely, a child having a yellow bracelet does not affect mothers' accurate knowledge, thus acting no differently than the yellow bracelet in the Uninformative treatment (see p>0.1 for UI Yellow = S5 or S4 Yellow). This aligns with the finding that mothers in Signal at 5 do not update their beliefs based on the yellow bracelet. For Signal at 4, this suggests that when mothers make inferences based on a yellow bracelet, they make more mistakes.[21] Mothers fail to recognize that a yellow bracelet on an older child can indicate that a child completed the vaccine but did so late. I interpret this as evidence that the yellow bracelet is a more difficult signal to learn from: parents need to know both the age of a child and the due date of a vaccine in order to interpret the signal correctly.

IV.C Learning from Actions about Types

Mothers believe that community members form opinions about their intrinsic motivation based on their child's vaccination status (Figure IV).[22] A vast majority of mothers (92%) assert that taking their child for all vaccinations, would lead others to view them as "caring", while failing to do so would lead others to judge them as "careless".[23] This confirms the underlying mechanism: vaccine completion is linked to being seen as a good

[19]This analysis focuses on mothers' actual knowledge, not perceived knowledge, to avoid potential bias from sample selection differences between yellow and green bracelets in the signaling treatments.

[20]Table III column 3 shows that mothers observing a child aged 3.5-9 months with a green bracelet in Signal at 5 are more likely to overestimate a child's vaccinations. The effect is driven by a few implementation errors and mothers incorrectly recalling a child's bracelet color.

[21]The results in column 2 of Table III indicate that, in Signal at 4, yellow bracelets cause mothers to be more likely to underestimate children's vaccinations compared to the Uninformative Bracelet (6.1 percentage points, p=0.21) and Signal at 5 (7.3 percentage points, p=0.08).

[22]Appendix Table B8 shows that community members are one of four main groups mothers believe are concerned about their child's vaccinations. Sixty-one percent of mothers name the child's father, and 65% name other family members, as being concerned about the child's vaccinations; while 30% and 35%, respectively, believe that community members and health workers are concerned.

[23]Mothers also mention specific actions they believe others will take. Seventy-four percent of mothers (Appendix Figure A6) believe they would be scolded for missed vaccinations, while 22% expect praise and positive remarks for completing vaccinations.

parent. In contrast, fewer mothers think that others associate their vaccine decisions with their knowledge about benefits (e.g. "know of importance of vaccination", or "are ignorant") or cost-related factors (e.g. "are too busy with work", or "too poor to travel to the clinic"). These responses also shed light on the question of what individuals aim to signal (Bursztyn and Jensen 2017): (i) that their child is healthy and does not pose a threat to other children (i.e., inference about a child's health status) or (ii) that they look after their child's health (i.e., inference about being a responsible parent). My findings suggest the latter. Most mothers view vaccines as beneficial only to their own child and lack an understanding of the externalities of vaccination. Less than 20% of mothers across all arms believe that unvaccinated children pose a risk to their child's health or that their child could harm others if not vaccinated (see Appendix Table B9).[24]

Importantly, I find no differences across arms regarding whom parents believe will judge them (Appendix Table B8), or the opinions they think others will form about them (Appendix Table B10 and B11). This suggests that the introduction of bracelets did not change existing social norms.

V Behavior: Do Signals Affect Vaccination Choices?

Having established that bracelets in the Signal at 4 and Signal at 5 treatments are perceived as informative about types, this section examines how the signaling incentives influence parents' behavior.

V.A Empirical Strategy

My preferred specification for the main outcome is:

$$Vaccine_i = \alpha + \beta T_{j(i)} + \delta X_i + \rho_{s(i)} + \varepsilon_i$$

in which Vaccine$_i$ denotes the binary outcome variable for a child i being vaccinated for $a \in \{1,2,3,4,5\}$ vaccines in a timely manner, that is by the age of three months for vaccine one, four months for vaccine two, five months for vaccine three, six months for vaccine four, and 11.5 months for vaccine five; $T_{j(i)}$ are treatment indicators for Signal at 4, Signal at 5, and the Uninformative Bracelet assigned at the clinic level (j); X_i denotes the control variables of distance to the clinic, clinic population size, a mother's ability to recall her child's last vaccine, and a vaccine-specific binary indicator that controls for the data source - i.e., whether the vaccine information was collected during the listing or the

[24]When asked why unvaccinated children can pose a risk to their child's health, or why their unvaccinated child could be harmful to others, mother cite reasons such as: "Because if she is not immunized, she can transfer diseases like measles if she happens to contact it". When asked why vaccinating their own child cannot help others, common responses include: "Because they do not have the same body, or same blood" or "Because the vaccines in my child won't jump and help other children".

follow-up survey; and $\rho_{s(i)}$ denotes the strata fixed effects. Standard errors are cluster bootstrapped at the clinic level. [25] The timeliness cut-offs were determined following WHO guidelines, which state that the DTP series should be completed by six months of age (WHO 2018).[26] I allow for a 2.5-month buffer window for each vaccine. For instance, for vaccine one, which is due at birth or shortly thereafter, the timeliness cut-off is set at three months. For vaccine two, which is due at 1.5 months, the cut-off is set at four months, and so on. Such a buffer is essential in this context: clinics in Sierra Leone do not offer vaccinations services daily, but instead have weekly or monthly vaccine days (Appendix Table B2).

In my main specification, I code children who received a given number of vaccines before the timeliness cut-off as one and zero otherwise. I consider alternative cut-offs to test the sensitivity of the results to my choice of cut-off (Appendix Table B13). Later in the analysis, I also examine the effect of bracelets on complete vaccination by the ages of 12, 18 and 24 months, independent of when a child received the vaccines.

In the main analysis, I use a constant sample of 4,897 children who I observe for all vaccinations up to the age of 12 months. Results are robust to including children for whom I only observe part of their vaccination history (Appendix Table B14). The discussion of the empirical results follows the experimental identification outlined in Section III.B.

V.B Effect of Signals on Timely Completion of 4 and 5 Vaccines

I find strong evidence that bracelets as signals effectively increase timely vaccinations when linked to the final vaccine. Appendix Table B12, Panel A shows the combined effect of Signals at 4 and 5, compared to the Control Group. In the Control Group, timely vaccination levels reveal a sharp drop-off between vaccines three and four (11.8 percentage points), and vaccines four and five (17.4 percentage points), underscoring the potential for parents to use bracelets to signal the timely completion of these vaccines. The signaling treatments increase the share of children completing vaccines four and five in a timely manner, from 73.9 to 79.9% (p=0.069) and from 56.5 to 63.1% (p=0.082), respectively. This represents a reduction in the drop-off by 51% and 38% compared to the Control Group. Although these differences are only marginally significant at the 10% level, they are economically meaningful.

The treatment effects mask substantial heterogeneity. Table IV, Panel A presents treatment responses for each signal separately. Signal at 4 led to a small and insignificant increase of 2 percentage points (p=0.58) in the timely completion of four vaccines and had no impact on the completion of five vaccines. In contrast, Signal at 5 let to a significant

[25] Standard errors are bootstrapped at the clinic level due to the low number of clusters in each study arm (30) and risk of downward bias for cluster robust standard errors (Cameron and Miller 2015).

[26] These guidelines vary by country. In LMICs, children are recommended to receive the first dose of the measles vaccine between nine and 12 months of age due to high infection risks (Carazo et al. 2020).

and large increase of 13.3 percentage points (p=0.001) in the timely completion of five vaccines. Comparing the Uninformative Bracelet with the Control Group reveals limited effects of bracelets as material incentives and reminders. Specifically, I find small and insignificant treatment effects for the Uninformative Bracelet: 2.1 (p=0.554) and 2.8 (p=0.497) percentage points for the fourth and fifth vaccines, respectively. The effects of Signal at 5 on the timely completion of five vaccines remain large and significant (10.5 percentage points with p=0.004) when compared to the Uninformative Bracelet, providing strong evidence for social signaling preferences.[27]

The increase in the timely completion of five vaccines is driven by two factors: firstly, children are more likely to take the fifth vaccine on time; secondly, those who would have taken the fifth vaccine on time regardless are now also more likely to take the fourth vaccine on time.[28] Signal at 5 increased the timely completion of four vaccines by 10.3 (p=0.002) and 8.2 (p=0.004) percentage points compared to the Control Group and Uninformative Bracelet, respectively. These behavior changes are rational given that receipt of the green bracelet was conditional on the timely completion of all vaccines up to the fifth vaccine. Importantly, the increase in take-up for the fourth vaccine in Signal at 5 raised vaccination rates to levels necessary for herd immunity against diphtheria at six months, a critical time when children are most at risk of contracting the disease.[29] In contrast, in the Control Group this level is only reached at 12 months.

The treatment effects of Signal at 5 on timely vaccinations are robust to applying stricter timeliness cut-offs (Appendix Table B13). When imposing cut-offs of 4.5 and five months for vaccine four, and ten and 11 months for vaccine five, the treatment effects change minimally and retain their significance.

Lastly, I examine whether the treatment effects are limited to cohorts first exposed to the bracelets. In Appendix Figures A7 and A8, I plot the time trends of the average treatment effects on timely completion of four and five vaccines and find that Signal at 5 consistently has large effects. Treatment effects remain stable for children born more than one year after the experiment began, ruling out that the novelty of bracelets drives behavior change.

[27] I report all estimates without control variables and find very similar results and significance levels (Appendix Table B15, Panel A).

[28] Appendix Table B16 quantifies these effects, showing treatment effects without conditioning on the timely completion of prior vaccines. For the fifth vaccine, a significant increase in the Control Group mean from 57% to 66% indicates that a substantial proportion of children do not receive the fourth vaccine on time but do receive the fifth on time. The treatment effect of Signal at 5 on the timely take-up of the fifth vaccine accounts for 66% of the overall effect on timely completion of all five vaccines (8.7 over 13.3 percentage points). The remaining 35% is attributable to children who were already receiving the fifth vaccine on time and are now also completing the fourth vaccine on time.

[29] Herd immunity for diphtheria requires 83 to 85% (Anderson and May 2013) of the population to be vaccinated with all three doses.

V.C Effect of Signal at 5 on Timely Completion of Earlier Vaccines

In addition to the treatment effects at vaccines four and five, Signal at 5 also significantly increased the share of children vaccinated in a timely manner for three (7.2 percentage points, p=0.009) and two (3.3 percentage points, p=0.003) vaccines compared to the Control Group (Table IV, Panel A). These increases are also significant when compared to the Uninformative Bracelet (4.4 and 1.6 percentage points with p=0.03 and p=0.07), providing further evidence for the relevance of social image concerns in this context.

The pattern of treatment effects implies that parents start adjusting their behavior six to nine months before realizing the signaling benefit associated with vaccine five. This behavior is consistent with predictions of a model where individuals strategically respond to the anticipation of future social image rewards (see Appendix D).

Table IV, column 6 combines the reduced form treatment estimates for all five vaccinations. Signal at 5 leads to a significant increases in the average number of vaccines completed in a timely manner from 4 to 4.4 over the Control Group, and from 4.1 to 4.4 over the Uninformative Bracelet, representing increases of 9 and 6% (p=0.001 and p=0.005), respectively.

V.D Extensive Margin Effects of Signals

Signals were tied to the timeliness of vaccinations up to either the fourth or fifth vaccine. However, policymakers may also be interested in whether signaling incentives not only improve timely vaccination but also increase the overall number of vaccines completed over the longer term, at 12, 18 and 24 months of age. To assess effects at 18 and 24 months, I analyze vaccine outcomes for the subsample of children who were surveyed during the follow-up.[30]

I observe the same pattern of results in vaccine completion at one year of age as I do for timely vaccination (Table IV and Appendix Table B12, Panel B), with Signal at 5's effects persisting up to two years of age (Table V). Almost all children in the Control Group receive the first three vaccines by 12 months, with completion rates at 99.3, 98.4 and 95.9%. Despite this, a substantial drop-off remains for the fourth and fifth vaccines, with only 91.7% and 68.6% of children, respectively, receiving these vaccines by one year of age. Signal at 5 significantly increases vaccination rates for these vaccines by 3.5 and 9.4 percentage points, respectively, compared to the Control Group (p=0.04 and p=0.005),

[30]The subsample is comparable to the full sample, as evidenced by the similar treatment effects on the completion of four and five vaccines at 12 months (see Table V, columns 1 and 4). Levels in the Control Group are slightly higher in this sub-sample due to attrition, as some children had moved or died by the time of the follow-up survey, leading to a positive selection towards children with better vaccination outcomes.

raising the average number of vaccines completed to 4.7 from 4.5 (p=0.005).[31] The impact on the fifth vaccine remains significant at 18 months with a 6.1 percentage point increase (p=0.041) and marginally so at 24 months with a 5.1 percentage point increase (p=0.086). The effect on the fourth vaccine is marginally significant at 24 months, with a 2.3 percentage point increase (p=0.076).

Comparisons between Signal at 5 and the Uninformative Bracelet provide further evidence for the signaling mechanism. At 12 months, completion rates for four and five vaccines are higher under Signal at 5, with increases of 2.7 and 6.5 percentage points (p=0.08 and p=0.03, respectively), raising the average number of vaccines received from 4.6 to 4.7 (p=0.04). At both 18 and 24 months, the effects on vaccine completion are large when compared to the Uninformative treatment, ranging from 2 to 5 percentage points, but I am only powered to detect such differences for four vaccines.

Of substantive policy relevance, bracelets raised vaccination rates for the fourth vaccine—the completion of the DPT series—to levels necessary for herd immunity against whooping cough. This threshold is reached five and eight months earlier than in the Control Group and Uninformative treatment, respectively.[32] These outcomes were achieved under real-world conditions, with imperfect implementation of the incentive by health workers (as evidenced by Section III.G, which shows green bracelets were correctly implemented for timeliness in only 64% of cases), demonstrating the potential effectiveness of using bracelets as a policy tool.

V.E Comparing the Effectiveness of Different Signals

To understand the strong impact of Signal at 5 compared to Signal at 4, I examine differences in experimental design, implementation, and belief results between the two treatments.

Both treatments had health workers implementing identical bracelet handouts and exchanges (see Appendix Table B17, column 2), with the only difference being the specific vaccine at which children received a green bracelet. Bracelets were equally visible and effective in increasing parents' beliefs about others' awareness of their child's vaccinations.

The fact that Signal at 4 has no effect on the timely completion of four vaccines is unlikely to be explained by a difference in marginal cost between the fourth and fifth vaccines, or by a difference in the number of individuals who are marginal for these two vaccines. Notably, Signal at 5 led to significant increases in the timely completion of not just five vaccines but also four, three, and two vaccines. Instead, the data suggest that parents place a higher value on signaling the timely completion of the fifth vaccine, as

[31] I report all estimates without control variables and find very similar coefficients and significance levels (Appendix Table B15, Panel B).

[32] Herd immunity against whooping cough requires a vaccination rate of 92 to 94% (Anderson and May 2013).

suggested by the greater bracelet retention rate. At endline, children in Signal at 5 are 10.4 percentage points less likely to have lost their bracelet, compared to those in Signal at 4 (Appendix Table B17, column 3, p=0.002).[33]

There are two plausible explanations for this difference in valuation. First, Signal at 5 is a more informative signal of a "caring" parent as it requires the timely completion of an additional vaccine that only 57% of parents achieve. In contrast, 74% of parents meet the requirement for Signal at 4. While Signal at 4 could be viewed as more informative about a "negligent" parent, given that only 26% of children fail to complete the initial four vaccines compared to 43% for vaccine five, this negative inference is not made because the yellow bracelet is a more complex signal to interpret.

Second, mothers may not fear negative judgment from others for delaying the fourth vaccine if it is viewed as less important. To understand mothers' perceptions of the benefits of different vaccines, I recorded at endline which vaccines they considered to be the most (and second most) important. Overall, mothers view the fourth vaccine as the least important of the five, while ranking the fifth vaccine as the second-most important, after the first vaccine (Table VI). These perceptions could imply that parents make different inferences when they see a child receiving a vaccine they consider "important" versus one they believe has lesser health value. Parents' perceptions align with the relative importance of the first measles dose compared to the third dose of the DTP series in terms of child health benefits, with the latter providing only marginal protection against diphtheria, tetanus, and pertussis. Additionally, the Government of Sierra Leone, along with its partners, regularly conducts nationwide measles campaigns to prevent outbreaks (EPI 2014).[34] The vaccine represents a milestone in the immunization schedule and has a distinctive name "9 month marklate" within communities, illustrating the existing awareness.

This raises the question: How informative is Signal at 4 about a child having received vaccine five? In other words, if Signal at 4 is as informative about the completion of vaccine five as is Signal at 5, then we would expect to see similar treatment effects for both, despite differences in perceptions. However, Signal at 4 increased mothers' beliefs about others' awareness of their child's fifth vaccinations to a much lesser extent compared to Signal at 5. In terms of magnitude, Signal at 4 was about two-thirds as informative about the completion of vaccine five as was Signal at 5 (Table II). Scaling the observed treatment effect of Signal at 5 on the timely completion of four vaccines accordingly,

[33] This result is not due to the additional time elapsed since children in Signal at 4 received their green bracelet compared to those in Signal at 5. Children aged 3.5 to 6.5 months, who would have recently received their bracelet in Signal at 4, are 27% more likely to have lost their bracelet compared to those in Signal at 5 (Appendix Table B17, column 4, $p<0.01$). By the time children are 9 to 12 months old, the difference in the share of children who lost their bracelet in Signal at 5 relative to Signal at 4 increases to 18.2 percentage points (p=0.007).

[34] Measles outbreaks surged after the Ebola epidemic (Colavita et al. 2017), increasing the salience of the disease.

we would expect a treatment effect of around 7.1 percentage points on four vaccines for Signal at 4.[35] The actual point estimate is 2, which is thus 3.5 times smaller. Given the noisiness of the coefficient, one should consider the confidence interval of the estimate [-5.3,9.3], which does include the value.

I interpret these results as evidence that linking signals to actions, which are both sufficiently valued and costly, can be effective at influencing behavior.

V.F Quantifying the Value of Bracelets

I use travel distance to the clinic as a numeraire to quantify the value parents assign to the bracelets and social signaling. Figure V displays the effect of distance on timely vaccinations. Each vaccine graph plots a bin scatter of the share of children vaccinated on time (for vaccines 2, 3, 4, and 5) against the distance from communities to clinics, for both the Control Group and Signal at 5. Distance has a linear effect on the probability of vaccination: in the Control Group, the share of children vaccinated on time declines by between 13 and 17 percentage points from zero to five miles for a given vaccine.

Signal at 5 mitigates the negative distance effect. It raises the share of children vaccinated at four miles distance to that of children vaccinated at zero miles. In other words, the bracelet increases parents' willingness to travel an additional four miles to clinics for a given vaccine. This effect is mainly driven by social signaling: in comparison to the Uninformative Bracelet, parents' willingness to travel increases by approximately three miles for each vaccine (Appendix Figure A9).[36]

It is important to note that distance was not exogenously varied in this experiment, so we should be concerned about the effect of distance on vaccination behavior being confounded by other observable or unobservable characteristics. While I cannot account for the latter, Appendix Tables B19 and B20 show that the inclusion of relevant observable characteristics, such as mothers' education, or the birth order of children, does not have a significant effect on the impact of distance on vaccinations in the endline sample.

VI Alternative Mechanisms

The experimental design does not account for two potential mechanisms through which Signal at 5 could have influenced behavior: the role of vaccine-specific reminders and social learning about the benefits, costs and social norms related to vaccinations.[37]

[35] This is computed by taking the second-order belief treatment effect for vaccine five (column 4 of Table II): 11.3pp/16.5pp = 0.68, then multiplying this ratio by the Signal at 5 treatment effect on the timely completion of four vaccines: 10.3pp · 0.68 = 7.

[36] I estimate a dynamic discrete-choice model (see Appendix E), showing that on average, parents value bracelets and the ability to signal equivalent to a walking distance of 6 to 7 miles.

[37] Separating the effects of vaccine-specific reminders from those of signaling is challenging, once actions become publicly visible. To control for vaccine-specific reminder effects, it would have been necessary to

The results of my experiment suggest that bracelets in the Signal at 5 treatment do not act as a reminder for vaccine five. If they did, I would expect to see similar treatment effects for Signal at 4 on vaccine four. Furthermore, I would not expect to observe increases in timely take-up of vaccines two, three, and four in Signal at 5.

Signal at 5 might also have altered perceptions regarding the benefits and costs of specific vaccines through social learning. For instance, witnessing health workers distribute green bracelets may lead parents to view vaccine five as more important. Nonetheless, the data do not support this explanation. I find no significant differences in individuals' perceptions of different vaccines between control and treatment groups (Table VI), suggesting that the treatment effects are not attributable to parents learning about the importance of vaccine five. Moreover, vaccine-specific learning cannot explain the treatment effects on earlier vaccines.

Evidence suggests that mothers in Signal at 5 held more positive beliefs about the benefits and potential harms of vaccines. While a vast majority (88.7%) of mothers in the Control Group perceive vaccines as beneficial for their child's health, mothers in Signal at 5 were 6.3 percentage points more likely (p=0.02) to believe that vaccines are helpful for their child's health, rather than both helpful and harmful, compared to all other arms (see column 1 in Appendix Table B9). I hypothesize that this shift in perceptions might stem from mothers who had a negative experience when taking their child for earlier vaccines being more likely to return for the fifth vaccine because of the Signal at 5 bracelet. Children are more likely to develop a fever in response to the DTP vaccines than to the measles vaccine. As a result, mothers' perceptions may be based on a more positive set of experiences.

Lastly, the signals may have influenced perceptions of social norms for vaccine uptake by affecting beliefs about the proportion of children receiving each vaccine. To test this hypothesis, I asked endline respondents how many out of ten children in their community (with ten representing a random sample of children) had completed each vaccine by one age year of age. Control Group respondents, on average, underestimate the percentage of children who completed the vaccines (Appendix Table B18). Respondents in both Signal at 4 and Signal at 5 believe that the share of children completing vaccines two through five is higher, by 4 to 5 percentage points, respectively. Yet, these differences are marginally significant or not significant compared to the Control Group, and insignificant compared to the Uninformative Bracelet. Importantly, the magnitude of these effects is small and, given the similar learning effects between Signal at 4 and Signal at 5, it is unlikely that these altered perceptions are driving the main findings.

implement a private reminder for vaccine five. This was logistically infeasible due to low phone ownership (see Appendix Table B1). Karing et al. (2023) show in a similar context that treatment effects from signaling persist, even in the presence of a private reminders.

VII Cost-Effectiveness

VII.A Cost Per Additional Fully Immunized Child

I estimate the cost per additional fully immunized child under the Signal at 5 bracelet version of the program. I compute the cost using data on actual expenses collected by the research partner during the study. These expenses include staff time, materials, and transport costs for training and monitoring health workers, and informing communities about the bracelets, but exclude data collection costs.[38] The program increased the share of fully immunized children at 12 months of age by 9.4 percentage points during the study period (Table IV, Panel B). Costs consist of the bracelets (US$0.92 per child) and implementation (US$1.28 per child), plus parents' costs of visiting the clinic (Table B21). This results in a total cost of US$24.7 per additional fully immunized child by 12 months of age.[39] The incentive cost alone per additional fully immunized child by 12 months is US$9.8. Since some parents, prompted by the program, will vaccinate their child eventually, the cost per additional fully immunized child (up to measles one) at 24 months rises to US$44.4.[40]

The program's cost-effectiveness is expected to increase when scaled up, as certain implementation costs, like health worker training, would be incurred less frequently, and fixed costs, such as personnel, would be distributed over a larger number of children. These estimates do not account for the government's costs and benefits. Assuming an adequate supply of vaccines, bracelets are likely to draw more children to clinics, thereby optimizing nurses' time and reducing government expenditure on vaccination outreach.

VII.B Comparison to Other Demand-Side Interventions

I compare the cost-effectiveness of the bracelets to other demand-side interventions costed in the literature, including SMS reminders, conditional cash transfers, in-kind incentives, and immunization ambassadors. My focus is on experimental studies published in peer-reviewed journals. The results are summarized in Table B21.

Gibson et al. (2017) find that offering a US$2 cash incentive for each timely vaccination, combined with SMS reminders, increases the rate of full immunization by 12 months of age from 82% to 90%. This approach resulted in a cost of US$90 per additional child fully vaccinated. Chandir et al. (2022) test the effectiveness of a mobile-based incentive in Pakistan and find that offering US$0.75 to US$1 for each vaccination leads to an additional child being fully immunized by 12 months of age at a cost of US$23. The

[38] Further details on the cost-effectiveness analysis methodology are available at poverty-action.org/cost-effectiveness-analysis.

[39] A 9.4 percentage points treatment effect requires reaching 10.64 children to immunize one additional child. Multiplying by the cost per child, i.e., US$2.2, gives a total of US$23.4.

[40] I compute the cost using the treatment effect reported in Table V.

setting of their study is most similar to mine, with full immunization rates of 56% in their control group.[41]

Banerjee et al. (2010) find that offering one kg of raw lentils for each vaccination and metal plates upon completing the full series increased full immunization rates in India from 18 to 39%. This strategy results in a cost of US$27.9 per additional fully immunized child. A more recent study by Banerjee et al. (2021), also conducted in an area of India with low vaccination rates, shows that immunization ambassadors, tasked with disseminating information about upcoming vaccination services, combined with SMS reminders, result in an additional child being fully immunized at a cost of US$21.

A meta-analysis by Eze et al. (2021) shows that SMS reminders alone on average increase immunization completion rates by 13%. While the marginal cost of sending SMS reminders becomes extremely low once a digital registration system is established for all immunization centers, the initial setup and maintenance costs of such a system can be prohibitive in contexts like Sierra Leone.

In summary, these estimates indicate that bracelets are on par with the most cost-effective interventions in this space, and can be more cost-effective than financial and in-kind incentives. It is important to note that these interventions were implemented in settings with varying baseline immunization rates. In areas with already high rates, achieving incremental increases can be more challenging and incur higher costs, given the larger number of children who are eligible for the incentive.

VIII Conclusion

A growing literature shows that social image concerns play an important role in a variety of settings. This paper demonstrates the potential for social signaling incentives to be used as a policy instrument to increase the timely uptake of vaccinations.

My analysis yields three important takeaways. First, it shows that households in resource-limited settings can be acutely aware of how other community members view their parenting decisions and are strongly motivated to engage in behaviors that portray them as responsible parents. Specifically, these households are 9 percentage points more likely to ensure their children are fully vaccinated by the age of one. This finding suggests that signaling incentives can serve as a powerful mechanism to encourage socially valuable actions, as in the context of parental investments in children's early-life health.

Second, by introducing variation in the actions that parents can signal, I demonstrate that the placement of signals can substantially influence behavior. My results indicate that signals are more effective when linked to a highly valued and costly action that is

[41] A large number of studies assess the effects of larger conditional cash transfers to encourage parents to utilize various health services (Munk et al. 2019). I am not reporting these here, as their cost-effectiveness estimates encompass outcomes beyond immunization.

informative about people's intrinsic motivation. This is relevant to the design of signaling incentives for other health behaviors with multiple visits (e.g., prenatal check-ups). Furthermore, my findings suggest that individuals are more influenced by positive than negative signals. Future research should examine the extent to which the effects of signaling incentives are driven by a desire for social reward or fears of stigma, as this has significant implications for the social welfare of such incentives (Butera et al. 2022).

Third, I demonstrate that the prospect of signaling motivates parents to exert greater effort, even when signaling benefits occur far in the future. Parents respond to the anticipated value of signaling by completing earlier vaccines in a timely manner. Future research should explore whether a non-linear incentive scheme—awarding a signaling benefit only after completing all vaccines—is optimal. Alternatively, a linear scheme, with signals at multiple points, might more effectively reduce drop-offs. While benefits might be smaller if signals provide less scope for parents to distinguish themselves, in contexts with high variance in cost shocks, even smaller signaling benefits at each vaccination could compensate for unexpected shocks.

Overall, this study's findings have important public policy implications. Signals increased immunization rates to levels required for herd immunity, and treatment effects persist up to two years of age. In addition, the cost-effectiveness of the Signal at 5 treatment, at USD 24.7 for each additional child fully vaccinated, compares favorably to that of the most impactful interventions in this space (Banerjee et al. 2010, 2021; Chandir et al. 2022). This demonstrates how a subtle behavioral intervention can address a common challenge in low-income countries: a shortage of trained health workers and a need for cost-effective methods that boost demand for clinic-based health services.

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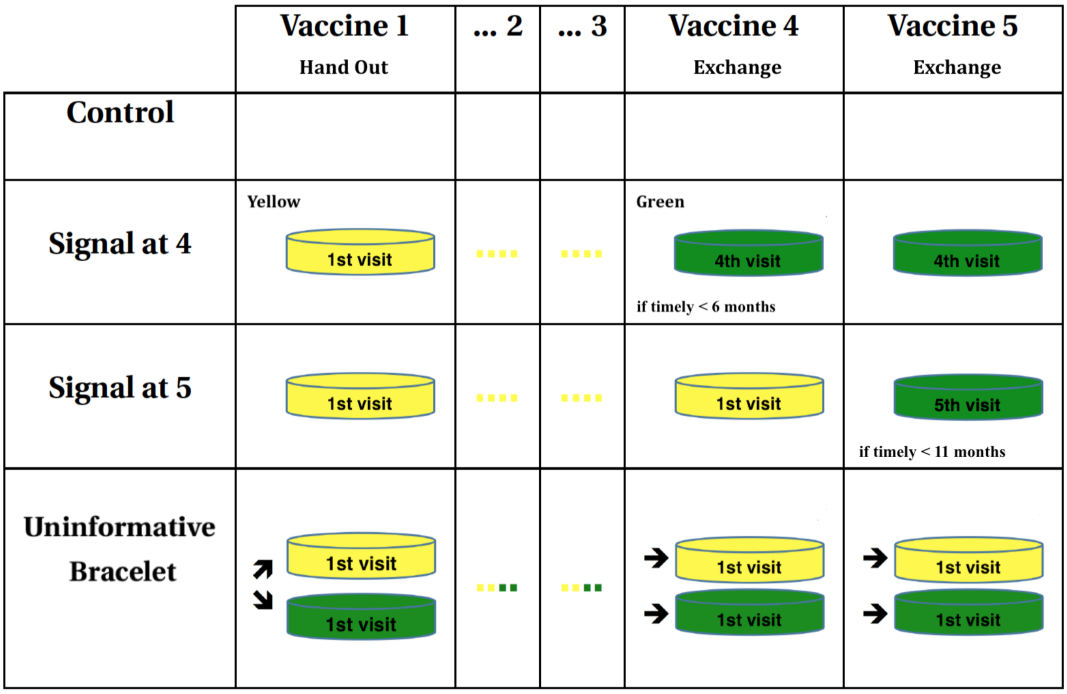

Figure I: Experimental Treatment Groups

Notes: This figure displays the four different experimental groups and the bracelet handout and exchanges that take place at each of the five vaccinations.

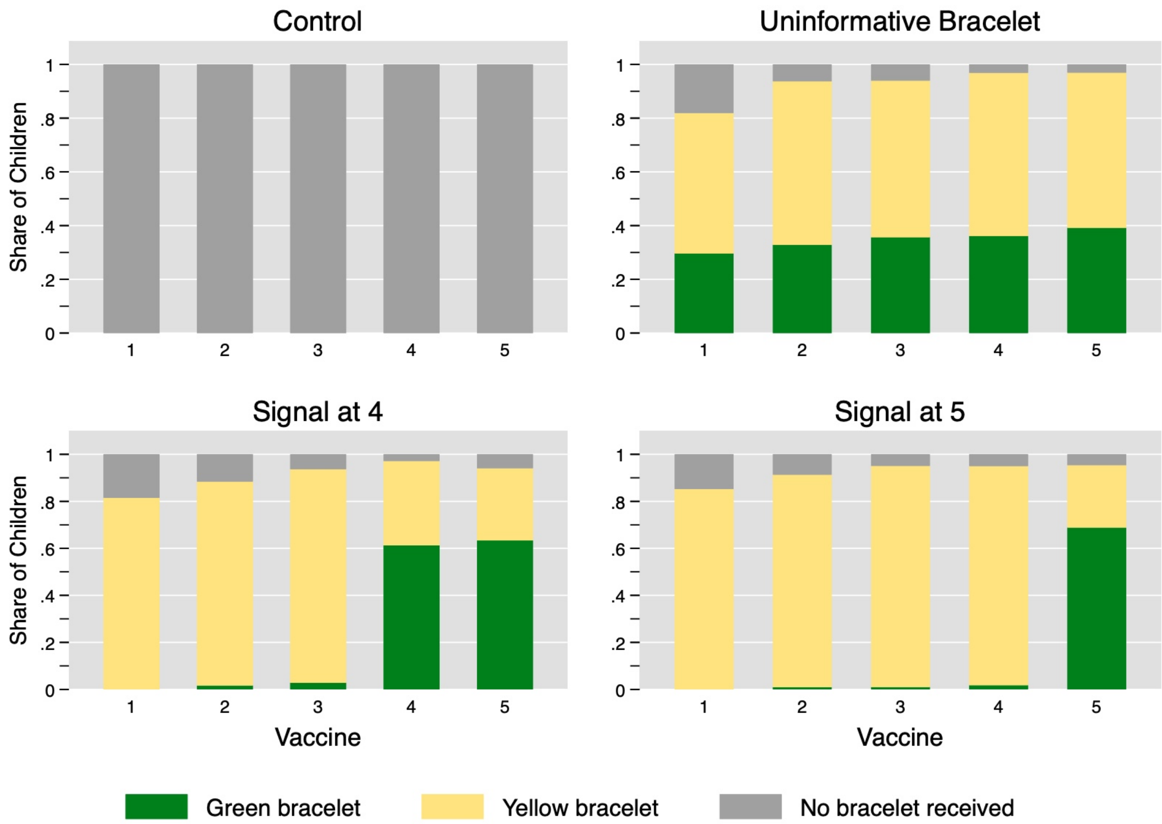

Figure II: Correct Handout of Bracelets by Treatment Groups

Notes: This figure displays the share of children with a green, yellow, or no bracelet conditional on the number of vaccines a child has received, separately for each experimental group. The sample includes 7,066 children (Control $N = 1,669$, Uninformative $N = 1,607$, Signal at 4 $N = 2,008$, Signal at 5 $N = 1,782$) that were born during the experiment, surveyed during the listing, and had received at least one vaccine. Surveyors asked each parent the color of bracelet they received upon vaccination, and recorded all vaccines the child had received up to that point.

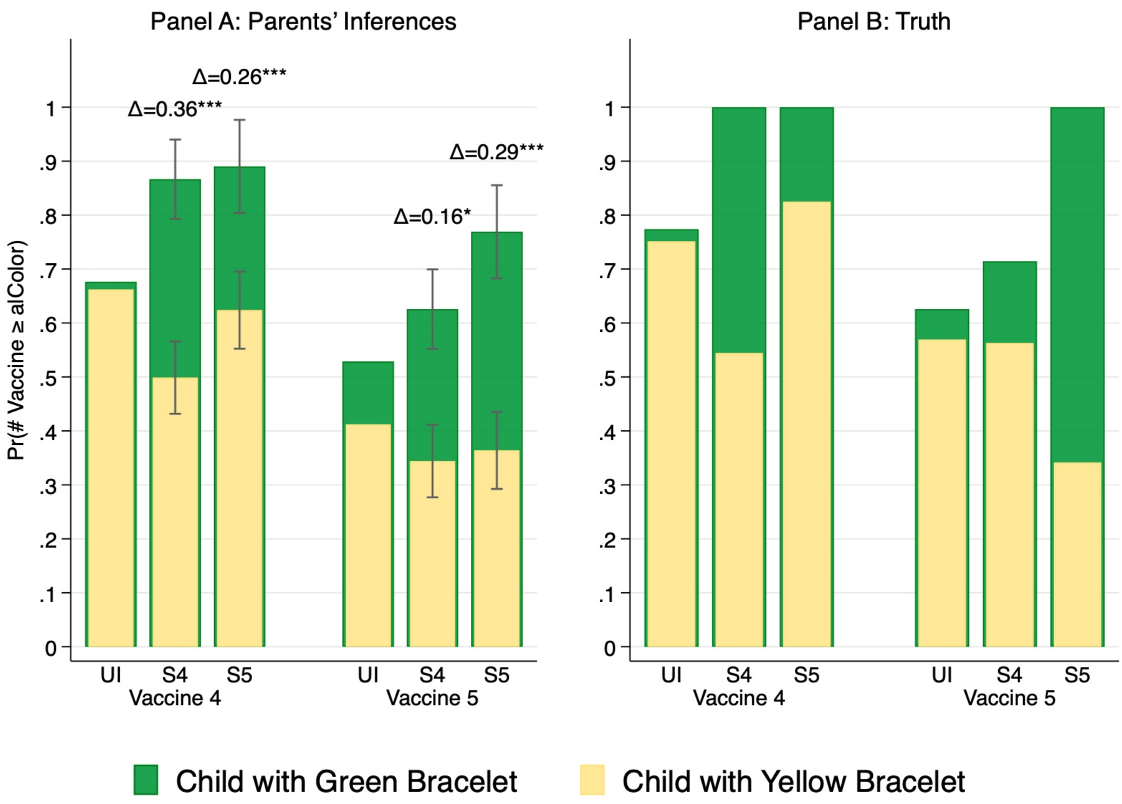

Figure III: Parents' Inferences about other Children's Vaccinations From Bracelet Colors

Notes: This figure shows endline respondents' beliefs about the number of vaccinations a child received conditional on the color of bracelet. Beliefs are presented by vaccine and by treatment, where UI = Uninformative Bracelet, S4 = Signal at 4, S5 = Signal at 5. The yellow and green bars depict the conditional probability of a child having received at least 4 or 5 vaccines, conditional on the respondent observing the child with a yellow or green bracelet. Δ represents the difference between these two conditional probabilities. The samples used for each vaccine include all children aged 3.5 to 9 months for vaccine four ($N = 1,866$) and 9 to 12 months for vaccine five (Vaccine 5 $N = 1,147$). The confidence intervals (at 95 percent) for Signal at 4 and Signal at 5 are depicted on the green and yellow bars, respectively. These intervals show the difference in beliefs in the signaling treatments compared to those in the Uninformative Bracelet. In estimating these probabilities in a regression framework, the analysis controls for the mean take-up level of Vaccine 4 or 5 at the clinic, a child's age and birth order, mother's age, level of education, primary economic activity, and her relationship to the other mother. All controls are demeaned, and all regressions include strata fixed effects. Standard errors are clustered at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

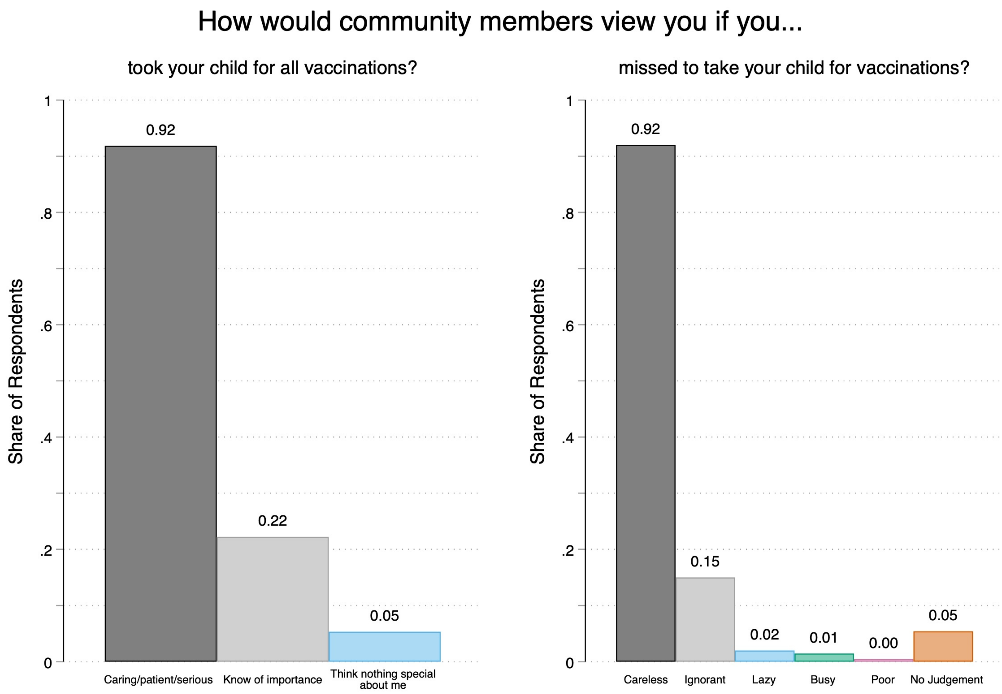

Figure IV: Reputational Costs and Benefits

Notes: This figure shows mothers' beliefs about the inferences that community members would make, conditional on observing that they took their child for all vaccinations or missed any. The sample consists of all respondents from the endline survey ($N = 1,314$). There are no significant differences in these beliefs across the experimental groups, as demonstrated in Tables B10 and B11.

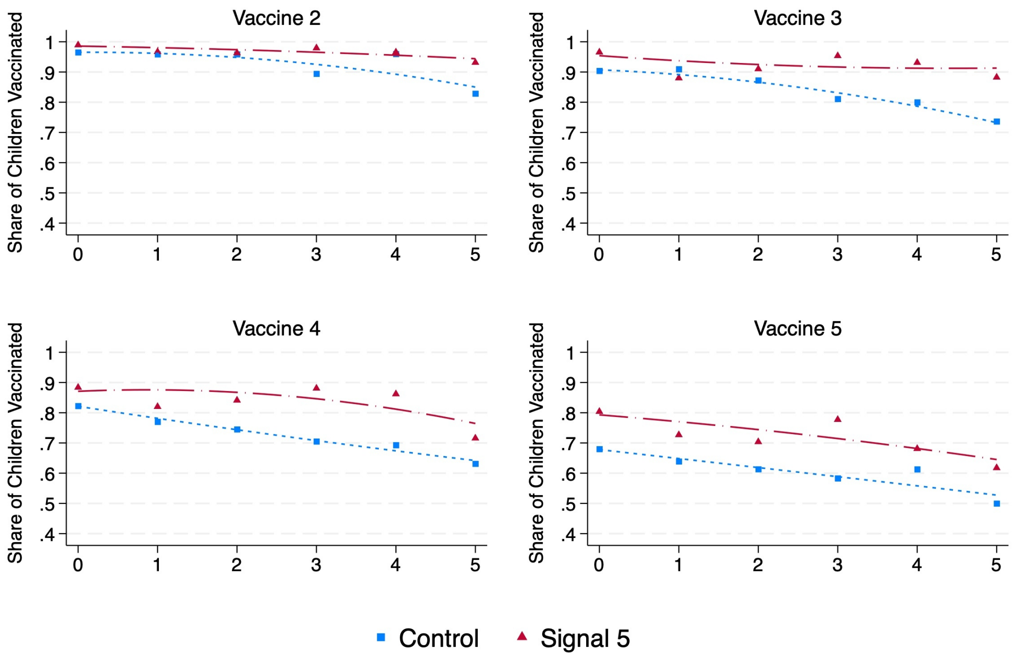

Figure V: The Effect of Distance to the Clinic on Timely Vaccination

Notes: The graph displays the impact of distance on the proportion of children vaccinated on time, by the number of vaccinations. It uses the main analysis sample ($N = 2,378$ for Control Group and Signal at 5). Each vaccine graph plots a bin scatter of the share of children vaccinated against the distance from communities to clinics, separately for the Control Group and Signal at 5.

Table I: The Visibility of Bracelets by Treatment Group

Dependent variable:	**Know if other child has a bracelet** (1)	**Know other child's bracelet color** (2)	**Others know if own child has a yellow or green bracelet** (3)	**Correct knowledge: other child has a bracelet** (4)	**Correct knowledge: other child's bracelet color** (5)
Signal at 4	0.035*	0.106***	0.051	0.054*	0.122***
	(0.020)	(0.022)	(0.038)	(0.032)	(0.047)
Signal at 5	0.011	0.082***	0.066	0.058	0.151***
	(0.020)	(0.024)	(0.040)	(0.037)	(0.056)
Uninformative Bracelet Group mean	0.896	0.802	0.755	0.832	0.496
Observations	3145	3145	2872	1170	1170
p(S4 = S5)	0.230	0.298	0.675	0.909	0.645
Controls	Yes	Yes	Yes	Yes	Yes

Notes: This table shows endline respondents' first- and second-order beliefs about the visibility of bracelets (columns 1-3), and how correct their knowledge is (columns 4-5). The unit of observation is a respondent-other mother pair. Know if other child has bracelet is a dummy variable that equals one if the respondent answered "Yes" or "No" and zero if she answered "Don't know". Know other child's bracelet color equals one if the respondent answered "Yellow" or "Green" and zero if she answered "Don't know". Others know if own child has a green or yellow bracelet is a dummy variable that equals one if the respondent answered "Yes" and zero if she answered "No" or "Don't know". All regressions include strata-fixed effects and demeaned control variables for mother and child. I control for a child's age and birth order, mother's age, her level of her education, whether her primary economic activity is farming, and her relationship to the other mother. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table II: The Effects of Signals on Second-Order Beliefs and Knowledge of Other Children's Vaccinations

Dependent variable:	**Others know # of vaccines of own child**		**Know # of vaccines of other children**	
Age in months	3.5-9 months	9-12 months	3.5-9 months	9-12 months
	(1)	(2)	(3)	(4)
Signal at 4	0.130**	0.113	0.040	0.084
	(0.053)	(0.070)	(0.041)	(0.051)
Signal at 5	0.075	0.165**	0.048	0.105**
	(0.058)	(0.074)	(0.042)	(0.049)
Uninformative Bracelet	0.080	0.058	0.021	0.026
	(0.055)	(0.074)	(0.040)	(0.051)
Control Group mean	0.481	0.468	0.497	0.429
Observations	2756	1627	2622	1592
$S_4 > 0$: p(UI = S4)	0.290	0.389	0.651	0.242
$S_5 > 0$: p(UI = S5)	0.929	0.111	0.540	0.088
p(S4 = S5)	0.279	0.403	0.860	0.672
Joint F-Test	0.104	0.126	0.655	0.106
Controls	Yes	Yes	Yes	Yes

Notes: The table shows endline respondents' second-order beliefs about a mother's own child's vaccinations and their knowledge about other children's vaccinations. The unit of observation is a respondent-other mother pair. Columns (1) and (2) show regression results of a binary variable for respondent's belief about another mother's knowledge of their child's vaccine status. The outcome variable is coded one if a respondent answered "Yes" the other mother has knowledge, zero otherwise. Columns (3) and (4) show regression results of a binary variable for correct knowledge of the number of vaccinations another child has received on treatment indicators for Signal at 4, Signal at 5, and Uninformative Bracelet, with the Control Group as excluded category. The outcome in each column is coded one if a respondent correctly guessed the number of vaccines the other child has. Columns (1) and (3) look at children in the earlier age range to assess the impacts of Signal at 4, and columns (2) and (4) look at older children when assessing the impacts of Signal at 5, as these are the periods when bracelets would be most informative about timely vaccination. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or of Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to that of the Signal at 5. Last is a joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned control variables for the mother and child. I control for a child's age and birth order, mother's age, her level of her education, whether her primary economic activity is farming, and her relationship to the other mother. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table III: The Effects of Signals on Knowledge of Other Children's Vaccinations by Bracelet Color

Dependent variable:	**Number of vaccines of other children**					
	Correct	**Underestimate**	**Overestimate**	**Correct**	**Underestimate**	**Overestimate**
Vaccine take-up period	3.5-9 months			9-12 months		
	(1)	(2)	(3)	(4)	(5)	(6)
Signal at 4	0.094*	-0.099**	0.004	0.078	-0.069	-0.009
	(0.057)	(0.041)	(0.043)	(0.068)	(0.062)	(0.046)
Signal at 5	-0.040	-0.146***	0.185*	0.171**	-0.207***	0.037
	(0.099)	(0.055)	(0.099)	(0.074)	(0.059)	(0.048)
Signal at 4 × Yellow Bracelet=1	-0.154**	0.160***	-0.006	-0.057	0.106	-0.050
	(0.066)	(0.062)	(0.046)	(0.089)	(0.086)	(0.057)
Signal at 5 × Yellow Bracelet=1	0.055	0.134*	-0.189*	-0.180*	0.215***	-0.035
	(0.096)	(0.069)	(0.101)	(0.099)	(0.082)	(0.058)
Yellow Bracelet=1	0.040	0.006	-0.046	0.044	0.033	-0.077*
	(0.046)	(0.048)	(0.037)	(0.058)	(0.057)	(0.041)
Mean Uninformative Bracelet	0.526	0.250	0.224	0.455	0.310	0.235
Observations	1623	1623	1623	1004	1004	1004
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p(S4 Green = S5 Green)	0.145	0.325	0.055	0.184	0.012	0.293
p(S4 Yellow = S5 Yellow)	0.136	0.083	0.941	0.701	0.691	0.213
p(UI Yellow = S4 Yellow)	0.279	0.213	0.975	0.769	0.626	0.227
p(UI Yellow = S5 Yellow)	0.758	0.785	0.912	0.887	0.899	0.965

Notes: The table shows endline respondents' knowledge of other children's vaccinations, conditional on bracelet color. The unit of observation is a respondent-other mother pair. Columns (1)-(6) show regression results of a binary variable for correct knowledge of the number of vaccinations another child has received on treatment indicators for Signal at 4, Signal at 5, with the Uninformative Bracelet as excluded category. The outcome in each column is coded one if respondents correctly guessed, under-, or over-guessed the number of vaccines the other child has. The Signal at 4 and 5 treatment indicators are interacted with respondent's belief about the bracelet color the other child has, with the excluded category being green. I exclude from the analysis mothers who either did not think the child had a bracelet, or could not remember if they had a bracelet or its color ($N = 545$). I run the same analysis with the full sample and find that the results do not change. The bottom rows give the p-values from a test that the effect of the green and yellow bracelets in Signal at 4 are equivalent to those in Signal at 5, and that the yellow bracelet in the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or Signal at 5 (S5). All regressions include strata-fixed effects and demeaned control variables for the mother and child. I control for a child's age and birth order, mother's age, her level of her education, whether her primary economic activity is farming, and her relationship to the other mother. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table IV: The Effects of Signals on Timely and Complete Vaccination, Separated by Treatment

Dependent variable:	**1 Vaccine**	**2 Vaccines**	**3 Vaccines**	**4 Vaccines**	**5 Vaccines**	**Total # of vaccines**
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4	-0.005	0.007	0.009	0.020	0.004	0.034
	(0.009)	(0.014)	(0.025)	(0.037)	(0.041)	(0.114)
Signal at 5	0.008	0.033^{***}	0.072^{***}	0.103^{***}	0.133^{***}	0.351^{***}
	(0.007)	(0.013)	(0.024)	(0.035)	(0.041)	(0.107)
Uninformative Bracelet	0.008	0.017	0.028	0.021	0.028	0.100
	(0.007)	(0.012)	(0.024)	(0.036)	(0.043)	(0.108)
Distance	-0.003^{**}	-0.009^{***}	-0.017^{***}	-0.027^{***}	-0.030^{***}	-0.086^{***}
	(0.001)	(0.003)	(0.003)	(0.004)	(0.005)	(0.014)
Control Group mean	0.979	0.940	0.858	0.740	0.567	4.042
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.097	0.383	0.374	0.989	0.487	0.481
$S_5 > 0$: p(UI = S5)	0.981	0.070	0.030	0.004	0.004	0.005
p(S4 = S5)	0.075	0.008	0.001	0.004	0.000	0.000
Joint F-Test	0.220	0.009	0.003	0.002	0.000	0.000
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4	0.002	0.009^{**}	0.013	0.019	0.033	0.075
	(0.003)	(0.004)	(0.009)	(0.017)	(0.033)	(0.057)
Signal at 5	0.002	0.009^{**}	0.019^{**}	0.035^{**}	0.094^{***}	0.159^{***}
	(0.003)	(0.004)	(0.008)	(0.016)	(0.033)	(0.057)
Uninformative Bracelet	0.003	0.010^{***}	0.011	0.008	0.029	0.061
	(0.003)	(0.004)	(0.008)	(0.017)	(0.035)	(0.059)
Distance	0.000	-0.000	-0.002^{**}	-0.008^{***}	-0.015^{***}	-0.025^{***}
	(0.000)	(0.001)	(0.001)	(0.002)	(0.004)	(0.006)
Control Group mean	0.993	0.984	0.959	0.917	0.687	4.541
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.499	0.804	0.807	0.445	0.890	0.754
$S_5 > 0$: p(UI = S5)	0.547	0.950	0.225	0.075	0.031	0.039
p(S4 = S5)	0.971	0.863	0.328	0.172	0.017	0.033
Joint F-Test	0.575	0.055	0.132	0.132	0.016	0.019
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) through (5) of this table, shows results from a linear probability model of the binary outcome variable for a child being vaccinated for 1, 2, 3, 4, or 5 vaccinations on treatment indicators for Signal at 4, Signal at 5 and Uninformative Bracelet, with the Control Group as the excluded category. Column (6) shows the results for the total number of vaccines a child has received. Panel A shows the results for timely vaccination by the age of 3, 4, 5, 6 and 11.5 months, respectively. For a child to be coded as timely for a given number of vaccines, they need to have been timely for all those vaccines. Panel B shows the results for vaccination by the age of 12 months, simply counting the total number of vaccines a child has received. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), identifying social signaling preferences, and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned controls for distance to the clinic, clinic population size, a mother's ability to recall her child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table V: The Effects of Signals on Complete Vaccination by 12, 18, and 24 months

Dependent variable:		**4 Vaccines**			**5 Vaccines**	
	by 12 months	by 18 months	by 24 months	by 12 months	by 18 months	by 24 months
	(1)	(2)	(3)	(4)	(5)	(6)
Signal at 4	0.012	0.013	0.017	0.024	0.028	0.034
	(0.018)	(0.014)	(0.014)	(0.039)	(0.032)	(0.032)
Signal at 5	0.028*	0.021	0.023*	0.085**	0.061**	0.051*
	(0.017)	(0.014)	(0.013)	(0.040)	(0.031)	(0.030)
Uninformative Bracelet	-0.009	-0.003	-0.004	0.010	0.013	0.021
	(0.020)	(0.016)	(0.015)	(0.042)	(0.034)	(0.031)
Control Group mean	0.936	0.951	0.952	0.736	0.828	0.848
Observations	3040	3040	3040	3040	3040	3040
$S_4 > 0$: p(UI = S4)	0.275	0.285	0.123	0.686	0.640	0.653
$S_5 > 0$: p(UI = S5)	0.042	0.094	0.047	0.036	0.135	0.303
p(S4 = S5)	0.214	0.404	0.517	0.038	0.208	0.532
Joint F-Test	0.156	0.277	0.147	0.061	0.202	0.402
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows results from a linear probability model with binary outcome variables for a child being vaccinated for 4 or 5 vaccines by 12, 18, or 24 months on a treatment indicator for Signal at 4, Signal at 5 and Uninformative Bracelet with the omitted category being the Control Group. Each vaccine outcome is coded to one if a child completed 4 or 5 vaccines, by ages 12, 18, or 24 months, and zero otherwise. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. All regressions include the distance from the community to the clinic, the clinic population size, and a mother's ability to recall her child's last vaccine. Regressions include strata-fixed effects and standard errors are clustered at the clinic-level. Standard errors are bootstrapped 1000 times. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table VI: The Effect of Signals on Preferences for Different Vaccinations

Dependent variable:	**Vaccine 1**	**Vaccine 2**	**Vaccine 3**	**Vaccine 4**	**Vaccine 5**	**All vaccines**
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Most Important Vaccine					
Signal at 4	-0.024	-0.013	0.006	-0.015	0.012	0.042
	(0.050)	(0.010)	(0.004)	(0.011)	(0.026)	(0.050)
Signal at 5	-0.022	-0.007	0.003	-0.019*	0.011	0.039
	(0.055)	(0.013)	(0.004)	(0.011)	(0.031)	(0.045)
Uninformative Bracelet	-0.019	0.001	0.010*	-0.008	-0.013	0.038
	(0.048)	(0.012)	(0.006)	(0.013)	(0.024)	(0.044)
Control Group mean	0.687	0.024	-0.000	0.024	0.108	0.146
Observations	1314	1314	1314	1314	1314	1314
$S_4 > 0$: p(UI = S4)	0.907	0.170	0.596	0.521	0.259	0.921
$S_5 > 0$: p(UI = S5)	0.956	0.525	0.328	0.264	0.370	0.977
p(S4 = S5)	0.965	0.642	0.604	0.596	0.957	0.947
Joint F-Test	0.964	0.441	0.160	0.313	0.658	0.760
Panel B:	Second Most Important Vaccine					
Signal at 4	-0.025	0.032	-0.003	0.032	-0.024	-0.006
	(0.026)	(0.060)	(0.032)	(0.029)	(0.051)	(0.019)
Signal at 5	0.024	0.091	-0.031	0.003	-0.066	-0.007
	(0.036)	(0.057)	(0.028)	(0.026)	(0.048)	(0.019)
Uninformative Bracelet	-0.010	0.025	-0.027	0.025	0.013	-0.016
	(0.024)	(0.056)	(0.027)	(0.029)	(0.047)	(0.017)
Control Group mean	0.098	0.378	0.107	0.057	0.315	0.032
Observations	1075	1075	1075	1075	1075	1075
$S_4 > 0$: p(UI = S4)	0.480	0.898	0.402	0.796	0.439	0.495
$S_5 > 0$: p(UI = S5)	0.296	0.202	0.891	0.360	0.086	0.511
p(S4 = S5)	0.140	0.274	0.342	0.232	0.358	0.944
Joint F-Test	0.471	0.383	0.576	0.536	0.345	0.776

Notes: This table shows results from a linear probability model of the binary outcome variables for vaccine 1, 2, 3, 4 or 5, or all vaccines being considered as most (Panel A) and second most (Panel B) important vaccine on treatment indicators for Signal at 4, Signal at 5 and Uninformative Bracelet, with the Control Group as excluded category. The sample includes all endline survey respondents ($N = 1,314$). For all columns, the bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. Regressions include strata-fixed effects. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

A Online Only Supplementary Figures

Figure A1: Different Bracelets handed out across Three Signaling Treatments

Notes: This image displays the bracelets that health workers give out at clinics: the yellow "1st visit" bracelet is used in Signal at 4, Signal at 5 and the Uninformative Bracelet; the green "1st visit" bracelet is given to children in the Uninformative treatment; the green "4th visit" bracelet is given to children in the Signal at 4 and the green "5th visit" bracelet to children in the Signal at 5 treatment.

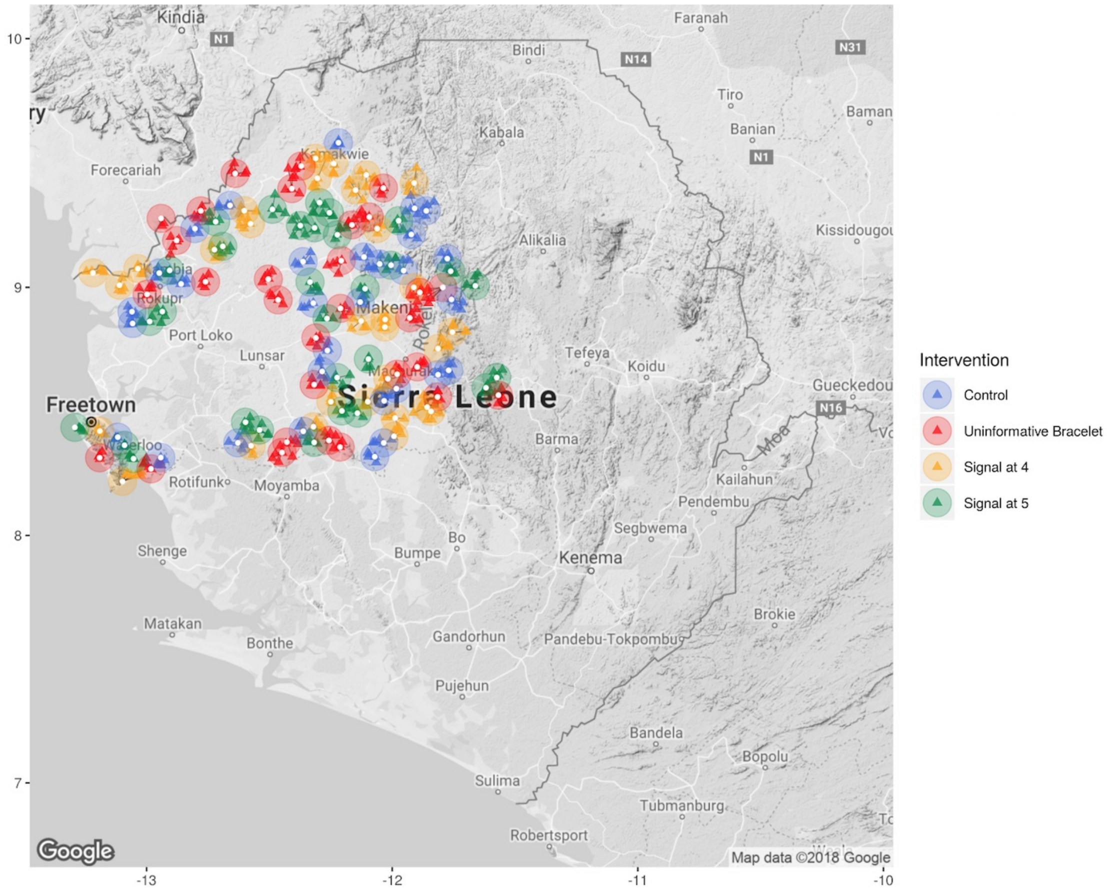

Figure A2: Clinic Randomization

Notes: This figure is a map of Sierra Leone that shows the geographic span of the experiment, with 120 clinics, that is 10% of Sierra Leone's public clinics, being randomized into the four different experimental groups. The clinic randomization was stratified by district. Four out of Sierra Leone's 14 districts were selected for the experiment in collaboration with the Ministry of Health and Sanitation of Sierra Leone, based on the criteria: i) baseline vaccination rates, ii) Ebola affectedness, iii) reliability of the supply side of immunization, and iv) other ongoing interventions. To avoid spillovers, the set of 120 clinics was chosen from a sample of 243 clinics, using an algorithm that ensured that each selected clinic had a catchment radius of 5 miles, of which at least 35% of the area was non-overlapping with any adjacent clinic's catchment area.

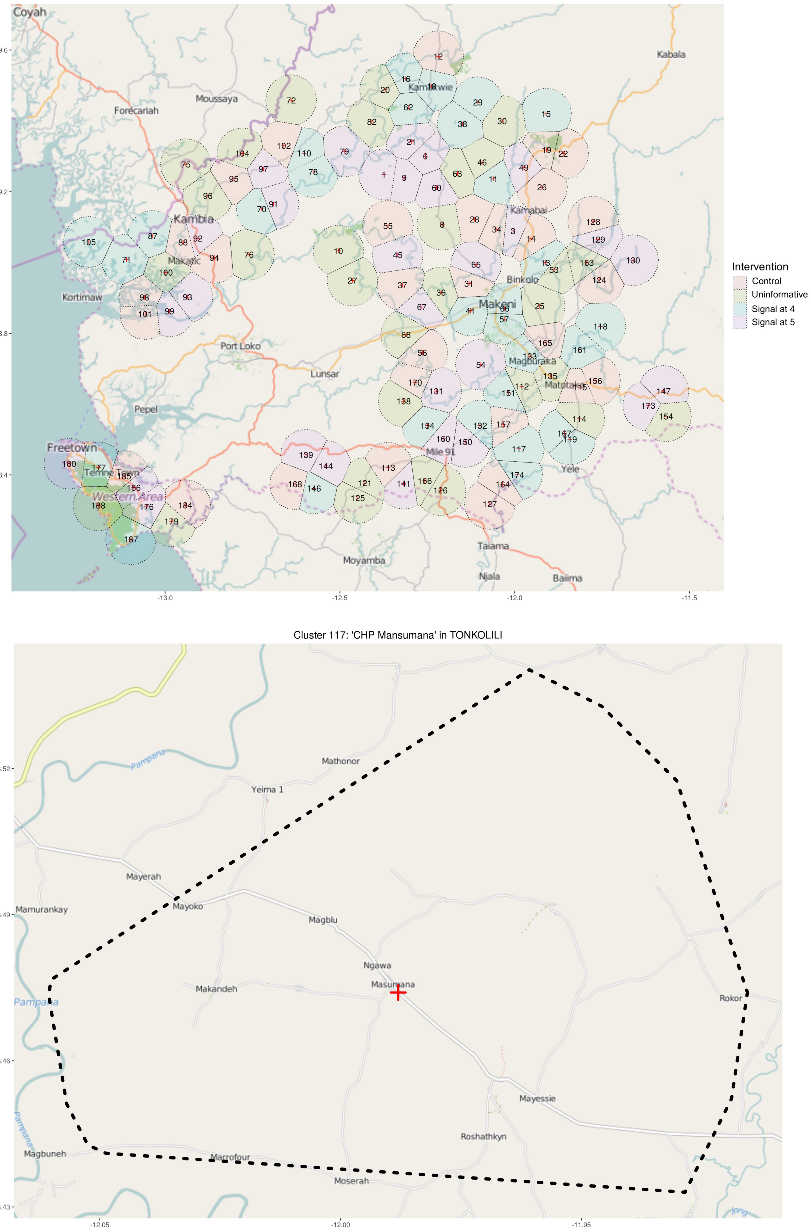

Figure A3: Process of Community Selection

Notes: The upper map displays the 120 selected clinics and their non-overlapping catchment areas, with radius of five miles around each clinic. The bottom map displays one of the 120 maps that surveyors were subsequently given. At baseline, surveyors obtained a list of all catchment communities from clinic staff. For each clinic, surveyors selected five communities, using in-field randomization. A community was considered as eligible for selection if it (i) was primarily served by the clinic, instead of by another close-by clinic, (ii) had at least ten dwelling units (a dwelling unit comprises on average of three to four households) and (iii) was not an outreach point, that is, a community where health workers would regularly travel to to vaccinate children. Among the five communities, one was by default the clinic community. In addition, one other close (located 0-2 miles from the clinic) community and three far communities (located 2-5 miles from the clinic) were randomly selected. For clinics that had fewer than three far or two close communities, surveyors were asked to replace the community with another close or far community.

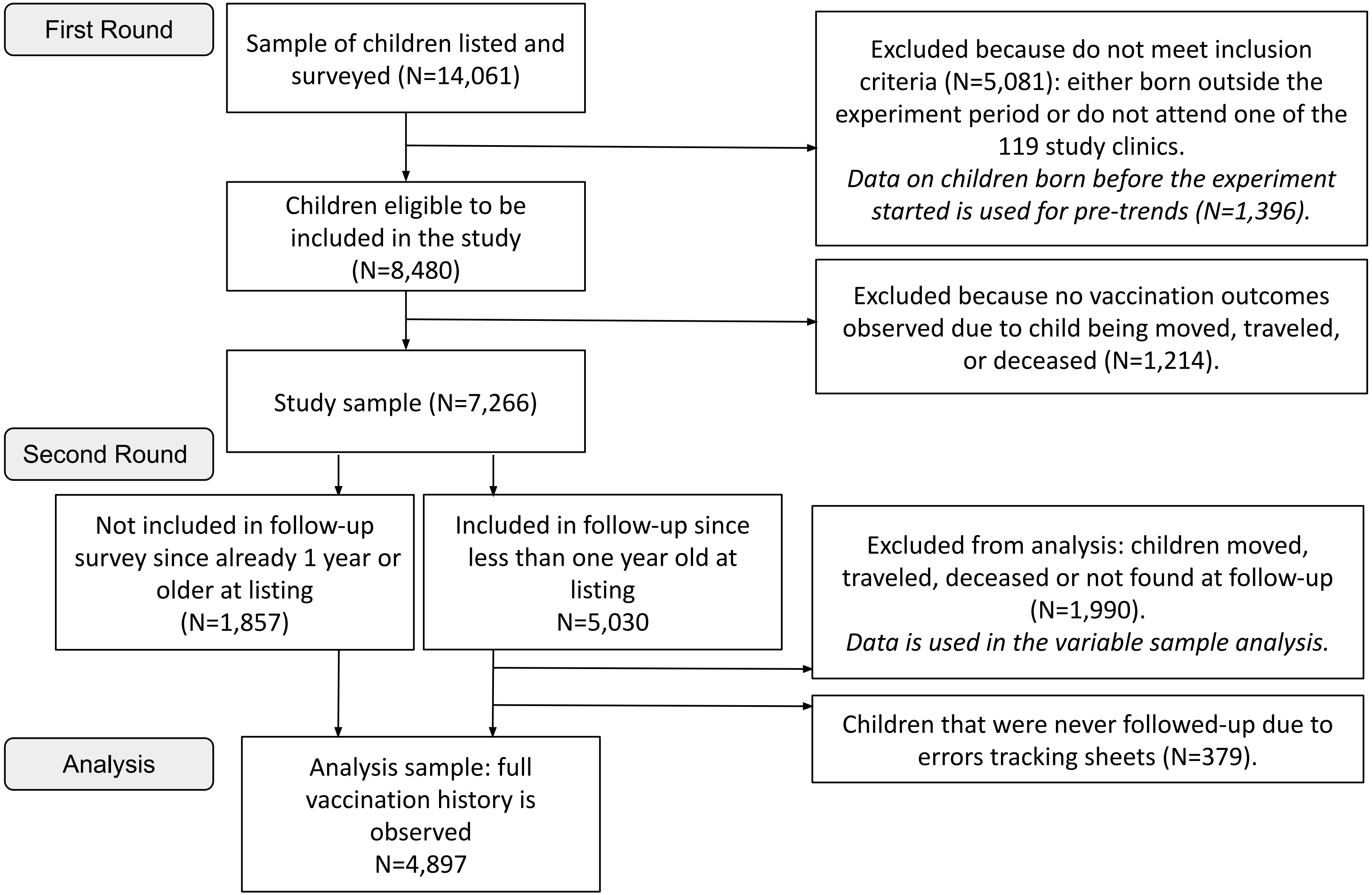

Figure A4: Final Sample Flow Diagram

Notes: This flow chart illustrates the sample sizes and exclusion criteria for each of the two rounds of data collection, the listing and follow-up surveys. It provides further detail on the sample definition for the main analysis described in Section III.F.

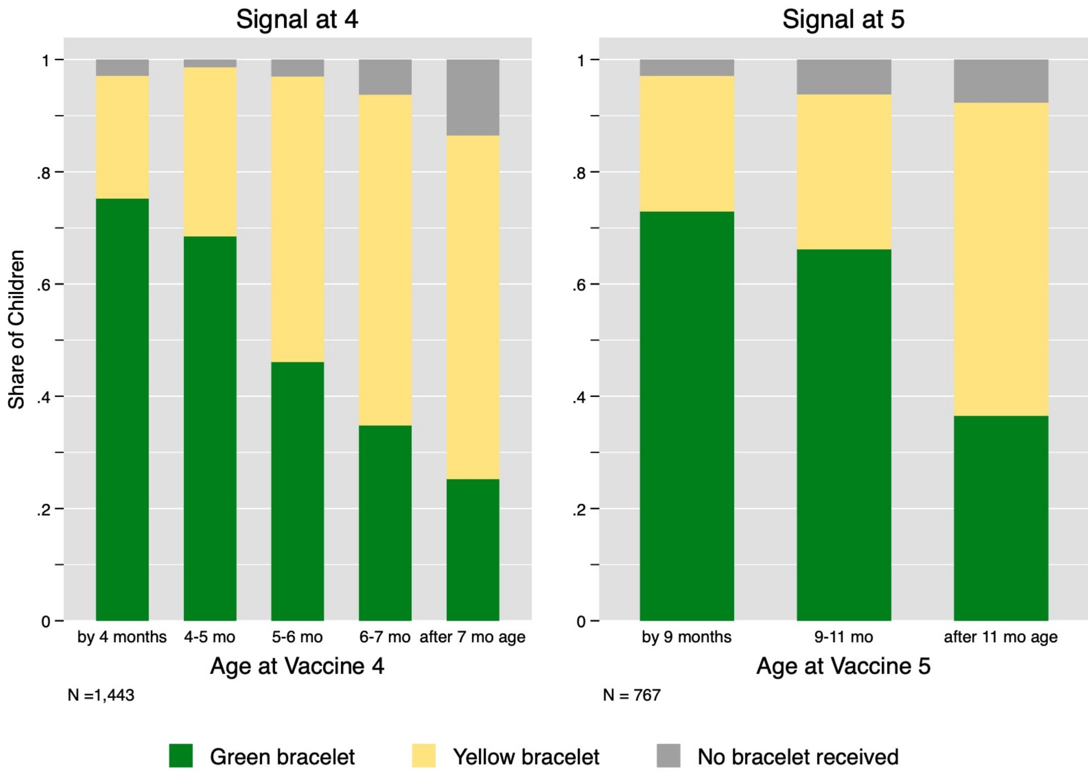

Figure A5: Handout of Green Bracelets in Signals at 4 and 5 according to Timely Vaccination

Notes: This figure shows the share of children with a green or yellow bracelet according to the time they took vaccines four and five in Signal at 4 and Signal at 5 treatments. Health workers were instructed to give the child a green bracelet if they came for the first four vaccines before six months of age (Signal at 4) and five vaccines before 11 months of age (Signal at 5). If a child came after this time, health workers were instructed to exchange their yellow bracelet for a new yellow "1st visit" bracelet instead. The sample includes children that were born during the experiment and surveyed during the listing. The panel on the left (Signal at 4) shows that the probability of receiving a green bracelet is monotonically decreasing in the age at which the child took vaccine four, from 75.2% if the vaccine was taken by four months age, to 68.7, 46.1, 34.8 and 25.2% if the child received the vaccine by 5, 6 or 7 months, or after 7 months age. The panel on the right (Signal at 5) shows a similar pattern: the probability of receiving a green bracelet decreases in the age at which the child comes for vaccine five, from 72.9% if the vaccine was taken by 9 months of age, to 66.2 and 36.5% by 11 months and after 11 months of age.

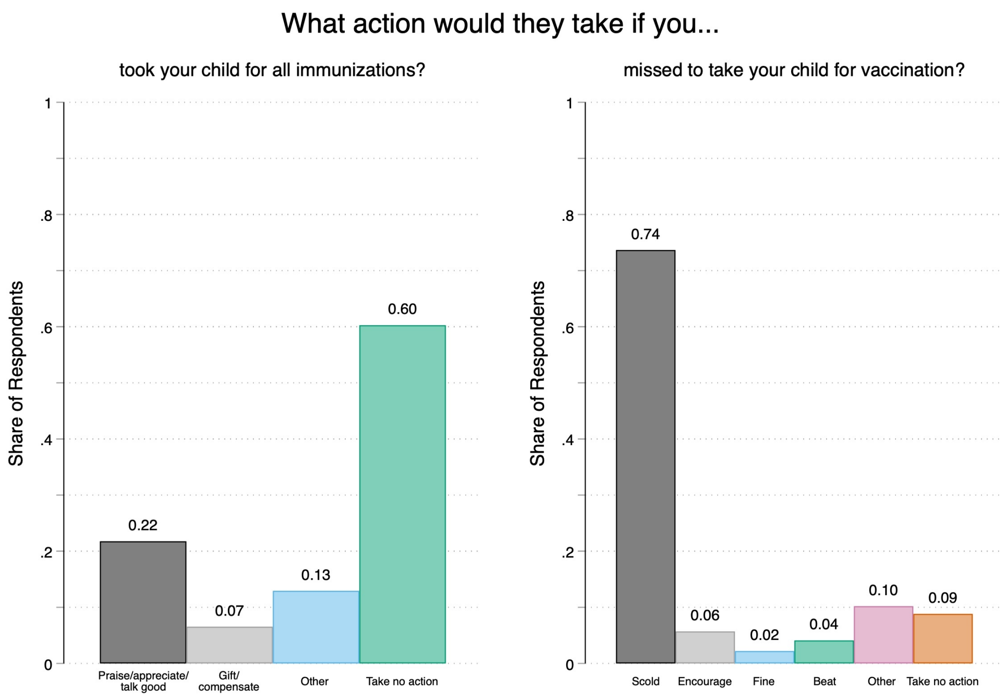

Figure A6: Reputational Costs and Benefits in terms of Actions

Notes: This figure shows mothers' beliefs about the actions that community members would take, conditional on observing that they took their child for all vaccinations or missed any. The sample consists of all respondents from the endline survey ($N = 1,314$). There are no significant differences in beliefs across treatment arms.

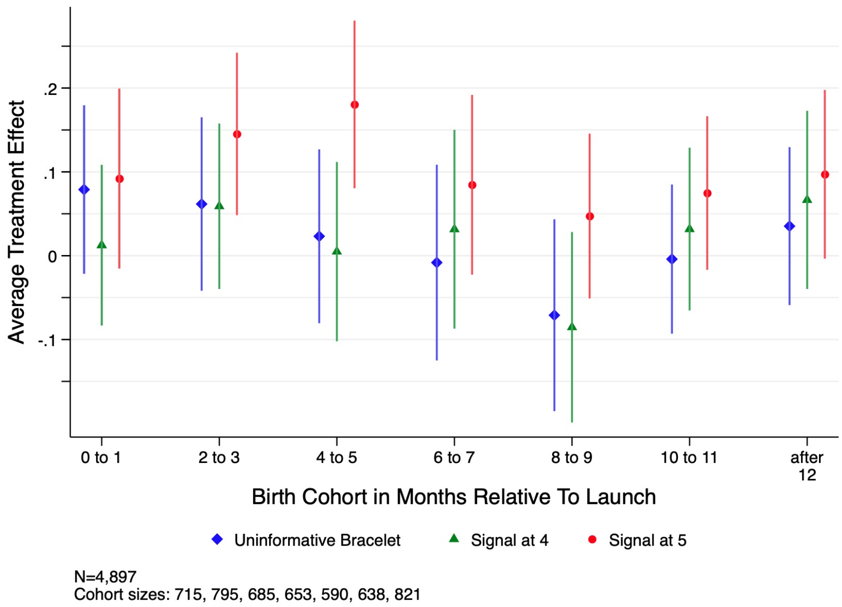

Figure A7: Treatment Effects by Birth Cohorts for Timely Vaccination - Vaccine 4

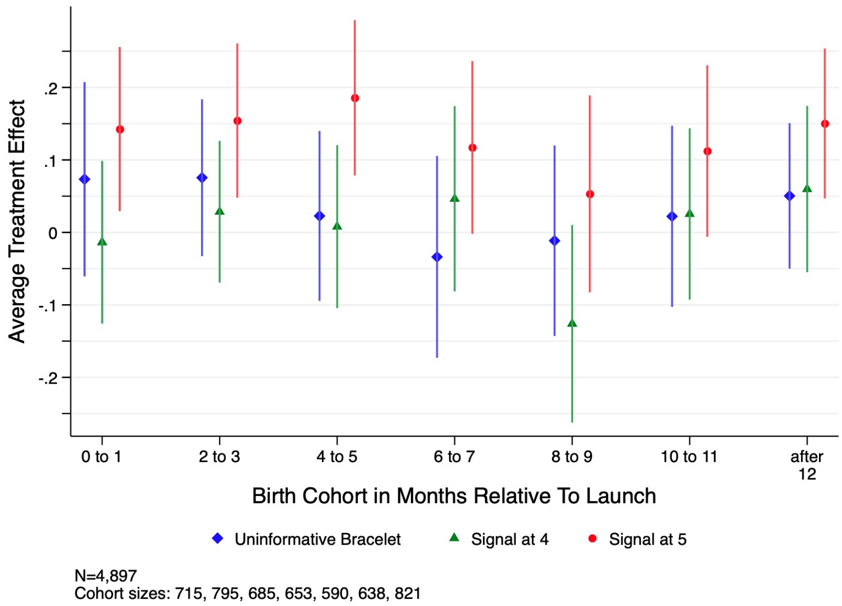

Figure A8: Treatment Effects by Birth Cohorts for Timely Vaccination - Vaccine 5

Notes: Figures A7 and A8 display the average treatment effects of Signal at 4, Signal at 5 and the Uninformative Bracelet treatment compared to the Control Group on timely vaccination of four and five vaccines, respectively, by birth cohorts. Children are grouped into birth cohorts of two months. With the exception of cohort 8-9, treatment effects for Signal at 5 are consistently between 8 and 17 for four vaccines and 11 and 19 percentage points for five vaccines. For Signal at 4, treatment effects are consistent over time, between -1 and 6 percentage points for four and five vaccines. For the Uninformative Bracelet, treatment effects are slightly more variable, ranging from -1 to 7 percentage points for four vaccines and -5 to 8 percentage points for five vaccines.

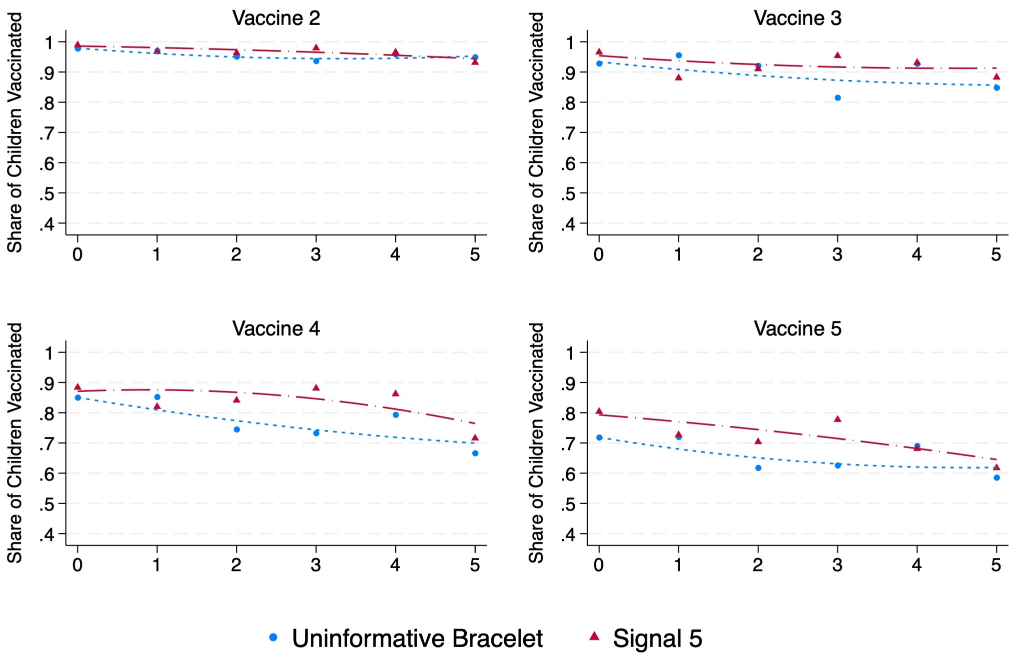

Figure A9: The Effect of Distance to the Clinic on Timely Vaccination

Notes: This graph displays the impact of distance on the proportion of children vaccinated on time, by the number of vaccinations. It uses the main analysis sample ($N = 2,311$ for the Uninformative Bracelet and Signal at 5). Each vaccine graph plots a bin scatter of the share of children vaccinated against the distance from communities to clinics, separately for the Uninformative Bracelet and Signal at 5. Signal at 5 mitigated the negative distance effect in the Uninformative Bracelet, increasing the share of children vaccinated at four miles to that of children vaccinated at one mile.

B Online Only Supplementary Tables

Table B1: Characteristics of Endline Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				t-test differences				
	Control			[p-value]				
Variable	**Mean/(SE)**	**(C)-(UI)**	**(C)-(S4)**	**(C)-(S5)**	**(UI)-(S4)**	**(UI)-(S5)**	**(S4)-(S5)**	**F-Test**
Panel A: Endline characteristics								
Interviewed the mother of the child	0.988	-0.012	-0.009	-0.009	0.003	0.003	0.000	0.112
	[0.006]	[0.031]	[0.165]	[0.065]	[0.308]	[0.330]	[0.737]	
Mother age (in years)	26.225	-0.275	-0.120	0.056	0.155	0.331	0.176	0.934
	[0.436]	[0.578]	[0.861]	[0.834]	[0.753]	[0.500]	[0.698]	
Is married	0.607	0.078	0.120	0.061	0.042	-0.017	-0.059	0.218
	[0.042]	[0.095]	[0.056]	[0.350]	[0.580]	[0.609]	[0.184]	
Temne ethnicity	0.515	-0.083	-0.043	-0.131	0.040	-0.048	-0.088	0.584
	[0.081]	[0.415]	[0.733]	[0.197]	[0.524]	[0.589]	[0.312]	
Limba ethnicity	0.269	0.074	0.069	0.091	-0.006	0.016	0.022	0.789
	[0.074]	[0.478]	[0.548]	[0.330]	[0.940]	[0.796]	[0.735]	
Lived in community for over 1 year	0.967	0.008	-0.009	-0.001	-0.017	-0.010	0.008	0.643
	[0.009]	[0.524]	[0.446]	[0.665]	[0.172]	[0.445]	[0.581]	
Observations		656	677	657	657	637	658	
Education								
Has no education	0.432	-0.062	-0.046	-0.035	0.016	0.027	0.011	0.454
	[0.030]	[0.101]	[0.246]	[0.205]	[0.805]	[0.439]	[0.844]	
Has some primary education	0.325	0.064	-0.002	0.018	-0.066	-0.046	0.020	0.125
	[0.027]	[0.025]	[0.871]	[0.555]	[0.058]	[0.129]	[0.589]	
Has some secondary education	0.243	-0.003	0.048	0.017	0.051	0.020	-0.031	0.598
	[0.029]	[0.888]	[0.286]	[0.396]	[0.144]	[0.646]	[0.454]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Occupation & Assets								
Works on farm	0.754	0.009	0.023	0.062	0.014	0.052	0.039	0.537
	[0.032]	[0.921]	[0.671]	[0.317]	[0.571]	[0.081]	[0.678]	
Has a mobile phone	0.112	0.006	0.000	-0.041	-0.005	-0.047	-0.042	0.282
	[0.022]	[0.734]	[0.961]	[0.444]	[0.618]	[0.019]	[0.150]	
Floor (1=Cement/Tile, 0=Mud)	0.331	-0.015	-0.049	-0.045	-0.035	-0.030	0.004	0.707
	[0.032]	[0.742]	[0.252]	[0.510]	[0.434]	[0.451]	[0.897]	
Roof (1=Corrugated iron, 0=Thatch)	0.896	0.041	-0.009	-0.016	-0.050	-0.057	-0.007	0.213
	[0.024]	[0.133]	[0.548]	[0.829]	[0.062]	[0.032]	[0.946]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Child characteristics								
Birth order of child	3.308	-0.186	-0.114	-0.068	0.072	0.118	0.046	0.546
	[0.100]	[0.143]	[0.366]	[0.412]	[0.608]	[0.457]	[0.835]	
Age of child (in months)	8.539	0.190	0.025	0.332	-0.165	0.142	0.307	0.503
	[0.191]	[0.552]	[0.987]	[0.073]	[0.549]	[0.557]	[0.289]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Panel B: First- and Second-Order Beliefs								
Number of children asked about	6.065	-0.466	-0.684	-0.493	-0.218	-0.027	0.191	0.481
	[0.384]	[0.242]	[0.095]	[0.291]	[0.607]	[0.776]	[0.507]	
Number of children recognized	4.154	0.066	-0.206	-0.197	-0.272	-0.263	0.009	0.100
	[0.115]	[0.981]	[0.125]	[0.024]	[0.118]	[0.090]	[0.945]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Set of controls: Sample 3.5-12 months								
Age of the mother interviewed	26.526	0.420	-0.030	0.098	-0.450	-0.323	0.127	0.797
	[0.457]	[0.412]	[0.963]	[0.824]	[0.318]	[0.510]	[0.753]	
Has some primary education	0.299	0.037	-0.034	0.010	-0.071	-0.027	0.044	0.489
	[0.029]	[0.320]	[0.638]	[0.879]	[0.128]	[0.380]	[0.390]	
Has some secondary education	0.256	0.013	0.066	0.035	0.053	0.022	-0.031	0.513
	[0.035]	[0.808]	[0.191]	[0.311]	[0.176]	[0.635]	[0.389]	
Works on farm	0.761	-0.019	-0.000	0.069	0.018	0.087	0.069	0.111
	[0.034]	[0.568]	[0.773]	[0.146]	[0.690]	[0.015]	[0.102]	
Close relationship to the other mother	0.414	-0.051	-0.012	0.029	0.038	0.080	0.042	0.238
	[0.027]	[0.267]	[0.705]	[0.531]	[0.304]	[0.023]	[0.213]	
Birth order of child	3.350	-0.108	-0.128	-0.056	-0.020	0.052	0.072	0.795
	[0.097]	[0.412]	[0.388]	[0.440]	[0.826]	[0.842]	[0.621]	
Observations		2140	2227	2204	2179	2156	2243	
Clinics		60	60	59	60	59	59	

Notes: This table summarizes socio-economic characteristics of endline survey respondents. I report the control group mean and pairwise mean differences for each variable and treatment group. Below the pairwise mean differences, I report the p-value from the t-test difference. The final column reports the joint significance level of treatment indicators in a regression with strata-level fixed effects. The values displayed for t-tests and F-tests are p-values. Standard errors are clustered at the clinic level.

Table B2: Description of Clinic and Community Characteristics

Variable	(1) Control Mean/(SE)	(2) (C)-(UI)	(3) (C)-(S4)	(4) (C)-(S5)	(5) (UI)-(S4)	(6) (UI)-(S5)	(7) (S4)-(S5)	(8) F-Test
		t-test differences [p-value]						
Panel A: Clinic characteristics								
Baseline characteristics								
# of staff involved in immunization	2.900	0.167	0.233	-0.134	0.067	-0.301	-0.368	0.884
	[0.435]	[0.654]	[0.607]	[0.526]	[0.989]	[0.856]	[0.596]	
Weekly vaccination services	0.700	0.100	0.067	0.010	-0.033	-0.090	-0.056	0.792
	[0.085]	[0.432]	[0.553]	[0.900]	[0.736]	[0.447]	[0.651]	
Stockout of vaccines in the past 2 months	0.200	0.100	0.067	0.062	-0.033	-0.038	-0.005	0.683
	[0.074]	[0.187]	[0.387]	[0.813]	[0.802]	[0.733]	[0.963]	
Observations		60	60	59	60	59	59	
Experiment implementation								
Timing of intervention roll-out (# of days relative to first clinic)	83.867	-0.933	-7.400	-11.099	-6.467	-10.166	-3.699	0.229
	[10.949]	[0.832]	[0.136]	[0.094]	[0.208]	[0.278]	[0.797]	
Time spent in communities for information meetings (in days)	1.867	-0.100	-0.333	-0.168	-0.233	-0.068	0.166	0.765
	[0.298]	[0.950]	[0.485]	[0.914]	[0.417]	[0.838]	[0.240]	
Time spent to list all babies in communities (in days)	3.300	0.000	0.167	-0.045	0.167	-0.045	-0.211	0.888
	[0.254]	[1.000]	[0.558]	[0.950]	[0.628]	[0.907]	[0.474]	
# of clinic monitoring visits during immunization services	7.300	-0.900	-1.500	-0.769	-0.600	0.131	0.731	0.118
	[0.494]	[0.235]	[0.020]	[0.205]	[0.296]	[0.979]	[0.237]	
Observations		60	60	59	60	59	59	
Service indicators collected throughout implementation								
Received a food supplement for child at last immunization visit	0.023	-0.004	-0.032	0.005	-0.028	0.009	0.037	0.165
	[0.009]	[0.771]	[0.057]	[0.742]	[0.092]	[0.473]	[0.037]	
Received a bednet at last immunization visit	0.062	0.023	0.021	0.013	-0.002	-0.010	-0.008	0.478
	[0.011]	[0.183]	[0.279]	[0.496]	[0.859]	[0.622]	[0.688]	
Gave money to the nurse at last immunization visit	0.146	0.006	-0.031	-0.014	-0.036	-0.020	0.016	0.895
	[0.031]	[0.815]	[0.531]	[0.793]	[0.486]	[0.758]	[0.768]	
Amount given to the nurse at last immunization visit (in Leones)	1605.556	242.063	-268.413	-361.111	-510.476	-603.175	-92.698	0.828
	[384.588]	[0.688]	[0.620]	[0.590]	[0.503]	[0.529]	[0.917]	
Immunization service was shifted in the last 2 months	0.083	-0.017	-0.045	-0.011	-0.028	0.005	0.034	0.668
	[0.021]	[0.446]	[0.225]	[0.721]	[0.472]	[0.913]	[0.402]	
Stockout of vaccines in the past 2 months	0.089	-0.012	0.032	0.022	0.044	0.034	-0.009	0.267
	[0.021]	[0.526]	[0.129]	[0.300]	[0.105]	[0.306]	[0.738]	
Observations		60	60	59	60	59	59	
Panel B: Community Characteristics								
Close community distance to clinic (in miles)	0.938	-0.076	0.019	0.050	0.095	0.126	0.031	0.499
	[0.066]	[0.456]	[0.948]	[0.990]	[0.218]	[0.238]	[0.832]	
Observations		154	154	160	148	154	154	
Clinics		60	60	59	60	59	59	
Far community distance to clinic (in miles)	3.667	-0.083	-0.073	-0.159	0.010	-0.075	-0.086	0.704
	[0.108]	[0.508]	[0.456]	[0.213]	[0.848]	[0.724]	[0.441]	
Observations		142	139	129	149	139	136	
Clinics		58	57	56	57	56	55	
Community knowledge								
Know # of vaccines required	0.951	-0.002	0.006	0.045	0.007	0.047	0.039	0.380
	[0.022]	[0.973]	[0.838]	[0.098]	[0.754]	[0.127]	[0.172]	
Observations		291	289	281	294	286	284	
Clinics		60	60	59	60	59	59	
Community perceptions								
Negligence from parents	0.817	-0.018	0.071	0.062	0.089	0.081	-0.008	0.642
	[0.050]	[0.916]	[0.225]	[0.397]	[0.213]	[0.768]	[0.731]	
Lack of knowledge of benefits	0.642	-0.001	0.015	-0.028	0.015	-0.027	-0.042	0.867
	[0.074]	[0.602]	[0.778]	[0.998]	[0.892]	[0.577]	[0.616]	
Distance to clinic	0.400	-0.050	-0.049	0.036	0.000	0.085	0.085	0.417
	[0.058]	[0.380]	[0.299]	[0.936]	[0.984]	[0.173]	[0.143]	
User fees	0.225	0.032	0.072	0.056	0.040	0.023	-0.017	0.794
	[0.061]	[0.897]	[0.688]	[0.564]	[0.617]	[0.542]	[0.929]	
Staff attitude	0.117	-0.003	-0.095	-0.002	-0.093	0.001	0.093	0.550
	[0.046]	[0.839]	[0.102]	[0.514]	[0.130]	[0.529]	[0.722]	
Observations		229	238	238	227	227	236	
Clinics		48	49	50	47	48	49	

Notes: This table summarizes relevant clinic and community characteristics collected at baseline and throughout the experiment. In Panel A, the unit of observation is a clinic. The clinic-level immunization service indicators under *Baseline characteristics* are collected by enumerators in a survey with the nurse in-charge of a respective clinic at baseline of the experiment. In Panel B, the information reported is on community level. The community characteristics were collected during the information meetings at the start of the experiment. I report the control group mean and pairwise mean differences for each variable and treatment group. Below the pairwise mean differences, I report the p-value from the t-test difference. The final column reports the joint significance level of treatment indicators in a regression with strata-level fixed effects. The values displayed for t-tests and F-tests are p-values. Standard errors are clustered at the clinic level.

Table B3: Characteristics of Main Analysis Sample

Variable	(1) Control Mean/(SE)	(2) (C)-(UI)	(3) (C)-(S4)	(4) (C)-(S5)	(5) (UI)-(S4)	(6) (UI)-(S5)	(7) (S4)-(S5)	(8) F-Test
		t-test differences [p-value]						
Panel A: Sample Definition								
Regular listed child	0.863	0.012	-0.008	0.015	-0.020	0.002	0.023	0.507
	[0.017]	[0.571]	[0.510]	[0.837]	[0.135]	[0.851]	[0.357]	
Traveled child	0.083	0.004	0.004	-0.002	0.000	-0.006	-0.006	0.977
	[0.011]	[0.906]	[0.791]	[0.929]	[0.832]	[0.782]	[0.836]	
Moved child	0.030	-0.011	0.006	-0.008	0.017	0.003	-0.014	0.045
	[0.006]	[0.287]	[0.153]	[0.913]	[0.007]	[0.504]	[0.063]	
Deceased child	0.025	-0.005	-0.002	-0.004	0.004	0.001	-0.003	0.861
	[0.005]	[0.612]	[0.868]	[0.723]	[0.414]	[0.754]	[0.745]	
Observations		3997	4378	4171	4309	4102	4483	
Listed child eligible for follow-up	0.730	0.000	-0.010	0.020	-0.011	0.020	0.030	0.475
	[0.015]	[0.946]	[0.598]	[0.369]	[0.564]	[0.282]	[0.102]	
Found & surveyed at follow-up	0.705	0.015	-0.025	-0.008	-0.039	-0.023	0.016	0.169
	[0.015]	[0.274]	[0.095]	[0.832]	[0.015]	[0.222]	[0.299]	
Traveled at follow-up	0.054	0.004	0.005	0.016	0.000	0.012	0.011	0.472
	[0.007]	[0.656]	[0.718]	[0.248]	[0.824]	[0.230]	[0.285]	
Moved at follow-up	0.172	-0.017	0.016	-0.000	0.032	0.017	-0.016	0.078
	[0.013]	[0.238]	[0.075]	[0.896]	[0.007]	[0.116]	[0.106]	
Deceased at follow-up	0.046	-0.001	0.009	-0.008	0.010	-0.007	-0.017	0.130
	[0.006]	[0.761]	[0.249]	[0.321]	[0.084]	[0.402]	[0.030]	
Was not found at follow-up	0.026	-0.002	-0.005	-0.002	-0.004	0.000	0.004	0.777
	[0.009]	[0.634]	[0.344]	[0.757]	[0.257]	[0.570]	[0.592]	
Observations		3238	3598	3351	3536	3289	3649	
Clinics		60	60	59	60	59	59	
Panel B: Sample Characteristics								
Age of child (in days)	236.692	2.806	4.858	1.433	2.052	-1.373	-3.425	0.928
	[5.625]	[0.776]	[0.612]	[0.617]	[0.870]	[0.647]	[0.474]	
Child has a vaccine card	0.953	-0.003	0.009	0.006	0.013	0.010	-0.003	0.756
	[0.009]	[0.843]	[0.365]	[0.491]	[0.298]	[0.496]	[0.832]	
Observations		2261	2586	2378	2519	2311	2636	
Vaccine Card is of good quality	0.830	0.019	0.008	-0.039	-0.011	-0.058	-0.047	0.309
	[0.032]	[0.755]	[0.700]	[0.231]	[0.971]	[0.081]	[0.101]	
Observations		1415	1786	1583	1651	1448	1819	
Mother's ability to recall last vaccine	0.863	-0.050	-0.041	-0.060	0.009	-0.010	-0.019	0.746
	[0.031]	[0.360]	[0.586]	[0.238]	[0.748]	[0.859]	[0.579]	
Observations		2261	2586	2378	2519	2311	2636	
Distance to clinic (in miles)	2.171	-0.229	-0.158	0.009	0.071	0.238	0.167	0.281
	[0.090]	[0.084]	[0.200]	[0.820]	[0.539]	[0.092]	[0.717]	
Communities		296	292	288	296	292	288	
Clinic population	66.833	3.667	-12.700	-6.615	-16.367	-10.282	6.085	0.197
	[5.491]	[0.653]	[0.199]	[0.492]	[0.097]	[0.064]	[0.643]	
Clinics		60	60	59	60	59	59	
Panel C: Pre-trends in vaccination outcomes								
Vaccine 1	0.970	0.018	0.014	0.000	-0.004	-0.018	-0.014	0.590
	[0.011]	[0.263]	[0.384]	[0.796]	[0.932]	[0.301]	[0.306]	
Observations		654	713	633	763	683	742	
Vaccine 2	0.911	0.025	0.004	-0.010	-0.021	-0.035	-0.014	0.604
	[0.019]	[0.336]	[0.611]	[0.832]	[0.797]	[0.175]	[0.372]	
Observations		510	539	491	575	527	556	
Vaccine 3	0.778	-0.038	-0.038	-0.029	-0.001	0.009	0.010	0.962
	[0.046]	[0.571]	[0.812]	[0.932]	[0.890]	[0.797]	[0.944]	
Observations		377	394	362	429	397	414	
Clinics		38	38	38	38	38	38	

Notes: This table summarizes relevant sample characteristics. The sample under Panel A consists of all children eligible to be included in the study, and for whom vaccination outcomes were captured during the listing. The panel shows balance on reasons for why vaccination outcomes could not be captured, eligibility for a follow-up, and status of the child/sample attrition at follow-up. Panel B shows balance on the characteristics of the sample used in the main specification of Tables IV and B12. In Panel C, I implement randomization checks on the immunization rates of children that were born before the start of the experiment and that resided in 76 of the study clinics. Due to budget constraints, I could only collect vaccine information for children born as early as January 2016. This allows me to access pre-trends for vaccines 1, 2 and 3 but not for vaccines 4 and 5. I report the control group mean and pairwise mean differences for each variable and treatment group. Below the pairwise mean differences, I report the p-value from the t-test difference. The final column reports the joint significance level of treatment indicators in a regression with strata-level fixed effects. The values displayed for t-tests and F-tests are p-values. Standard errors are clustered at the clinic level.

Table B4: Characteristics of 24 Months Analysis Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				t-test differences [p-value]				
Variable	**Control Mean/(SE)**	**(C)-(UI)**	**(C)-(S4)**	**(C)-(S5)**	**(UI)-(S4)**	**(UI)-(S5)**	**(S4)-(S5)**	**F-Test**
Panel A: Sample Definition								
Found & surveyed at follow-up	0.598	0.020	-0.038	-0.002	-0.058	-0.022	0.036	0.077
	[0.019]	[0.273]	[0.074]	[0.961]	[0.005]	[0.303]	[0.090]	
Traveled at follow-up	0.073	0.006	0.008	0.022	0.002	0.016	0.014	0.397
	[0.009]	[0.626]	[0.596]	[0.187]	[0.826]	[0.177]	[0.295]	
Moved at follow-up	0.232	-0.021	0.023	-0.004	0.044	0.017	-0.027	0.070
	[0.018]	[0.318]	[0.075]	[0.981]	[0.007]	[0.191]	[0.050]	
Deceased at follow-up	0.063	-0.002	0.014	-0.013	0.015	-0.011	-0.026	0.062
	[0.009]	[0.734]	[0.218]	[0.268]	[0.058]	[0.345]	[0.011]	
Was not found at follow-up	0.035	-0.003	-0.007	-0.003	-0.004	0.000	0.004	0.801
	[0.012]	[0.520]	[0.368]	[0.739]	[0.278]	[0.508]	[0.710]	
Observations		2370	2651	2425	2605	2379	2660	
Clinics		60	60	59	60	59	59	
Panel B: Sample Characteristics								
Age of child (in days)	155.400	3.393	-3.266	5.739	-6.659	2.346	9.005	0.272
	[6.305]	[0.494]	[0.623]	[0.186]	[0.186]	[0.606]	[0.084]	
Child has a vaccine card	0.975	0.002	0.010	0.011	0.008	0.009	0.001	0.421
	[0.008]	[0.384]	[0.039]	[0.238]	[0.460]	[0.764]	[0.906]	
Observations		1393	1639	1452	1588	1401	1647	
Vaccine Card is of good quality	0.806	0.021	-0.008	-0.053	-0.028	-0.073	-0.045	0.236
	[0.040]	[0.704]	[0.994]	[0.175]	[0.718]	[0.040]	[0.120]	
Observations		1078	1331	1163	1267	1099	1352	
Mother's ability to recall last vaccine	0.825	0.052	-0.041	0.002	-0.093	-0.050	0.044	0.169
	[0.033]	[0.334]	[0.369]	[0.392]	[0.042]	[0.265]	[0.266]	
Observations		1393	1639	1452	1588	1401	1647	

Notes: This table summarizes relevant sample characteristics for the subsample of children included in the analysis of vaccination outcomes at 24 months of age. The sample under Panel A consists of all children eligible for the follow-up survey, and displays balance on sample attrition and reasons for attrition at follow-up. Panel B shows balance on the characteristics of the sample used in the 24 months analysis (Table V). I report the control group mean and pairwise mean differences for each variable and treatment group. Below the pairwise mean differences, I report the p-value from the t-test difference. The final column reports the joint significance level of treatment indicators in a regression with strata-level fixed effects. The values displayed for t-tests and F-tests are p-values. Standard errors are clustered at the clinic level.

Table B5: Verifying the Correct Implementation of Bracelets, Regression Results for Figure II

Dependent variable:	**Signal at 4**		**Signal at 5**		**Uninformative Bracelet**	
	Green	**Yellow**	**Green**	**Yellow**	**Green**	**Yellow**
	(1)	(2)	(3)	(4)	(5)	(6)
Vaccine 2	0.015	0.055	0.016***	0.046	0.035	0.092
	(0.010)	(0.050)	(0.006)	(0.038)	(0.057)	(0.070)
Vaccine 3	0.023	0.095*	0.017**	0.078**	0.057	0.068
	(0.018)	(0.055)	(0.007)	(0.038)	(0.049)	(0.062)
Vaccine 4	0.612***	-0.448***	0.028***	0.070**	0.064	0.080
	(0.036)	(0.075)	(0.007)	(0.032)	(0.055)	(0.058)
Vaccine 5	0.629***	-0.501***	0.697***	-0.592***	0.090	0.056
	(0.042)	(0.073)	(0.036)	(0.051)	(0.056)	(0.055)
Mean Vaccine 1	0.002	0.810	-0.008	0.860	0.298	0.523
p(Vaccine 3 = Vaccine 4)	0.000	0.000	0.183	0.649	0.847	0.759
p(Vaccine 4 = Vaccine 5)	0.642	0.110	0.000	0.000	0.368	0.407
Observations	2008	2008	1782	1782	1607	1607

Notes: This table shows the regression results of a binary variable for a green or yellow bracelet on the total number of vaccines a child has received, by treatment group (shown in Figure II). I include strata fixed effects and cluster standard errors at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B6: How Mothers Know about the Color of the Bracelet

	How do you know that this baby has a green/yellow bracelet?			
Dependent Variable:	**Saw bracelet on child**	**Saw child getting bracelet**	**Everyone gets a bracelet**	**Right # of vaccines**
	(1)	(2)	(3)	(4)
Signal at 4	-0.064	0.028	-0.009	0.078***
	(0.047)	(0.048)	(0.021)	(0.019)
Signal at 5	-0.065	0.032	0.034	0.068***
	(0.044)	(0.053)	(0.026)	(0.014)
UI Group Mean	0.826	0.365	0.047	0.001
Observations	2627	2627	2627	2627
p(S4 = S5)	0.994	0.949	0.093	0.656

Notes: This table summarizes bracelet knowledge at endline. The unit of observation is a respondent-other mother pair. I asked respondents in the Uninformative Bracelet, Signal at 4, and Signal at 5 clinics, whether they knew that the other mother's child has a bracelet, and if so, how they know that the child has a green or yellow bracelet. Outcome variables equal one if the respondent mentioned the respective choice, and zero otherwise. Each respondent was able to provide multiple reasons. In this table, I focus on the top 4 responses, excluding those with very low frequencies (less than 5% for the whole sample). The excluded reasons which were cited by more than 1% are "Mother showed me the bracelet" (named by 1.9%) and "Because of the age of the child" (named by 1.4%). In all regressions, I include strata-fixed effects, demeaned controls for the mother and child. I control for a child's age and birth order, mother's age, her level of her education, whether her primary economic activity is farming, and her relationship to the other mother. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B7: The Effects of Signals on Vaccine Knowledge by Bracelet Color (without Controls)

Dependent variable: Others know number	**Number of vaccines of other children**					
	Correct	**Under**	**Over**	**Correct**	**Under**	**Over**
Vaccine take-up period	3.5-9 months			9-12 months		
	(1)	(2)	(3)	(4)	(5)	(6)
Signal at 4	0.128**	-0.116***	-0.013	0.074	-0.054	-0.020
	(0.059)	(0.040)	(0.050)	(0.066)	(0.058)	(0.048)
Signal at 5	0.018	-0.176***	0.158	0.160**	-0.201***	0.042
	(0.100)	(0.055)	(0.099)	(0.075)	(0.058)	(0.060)
Signal at 4 × Yellow Bracelet=1	-0.208***	0.189***	0.019	-0.058	0.102	-0.044
	(0.068)	(0.063)	(0.047)	(0.088)	(0.081)	(0.057)
Signal at 5 × Yellow Bracelet=1	0.004	0.168**	-0.171*	-0.175*	0.198**	-0.023
	(0.098)	(0.070)	(0.100)	(0.096)	(0.080)	(0.063)
Yellow Bracelet=1	0.046	0.001	-0.047	0.023	0.029	-0.051
	(0.046)	(0.049)	(0.037)	(0.059)	(0.055)	(0.048)
Mean Uninformative Bracelet	0.519	0.253	0.228	0.469	0.308	0.223
Observations	1623	1623	1623	1004	1004	1004
Controls	No	No	No	No	No	No
p(S4 Green = S5 Green)	0.246	0.198	0.072	0.221	0.005	0.239
p(S4 Yellow = S5 Yellow)	0.058	0.049	0.575	0.684	0.517	0.096
p(UI Yellow = S4 Yellow)	0.175	0.138	0.858	0.824	0.517	0.203
p(UI Yellow = S5 Yellow)	0.677	0.852	0.649	0.815	0.955	0.743

Notes: This table shows the same regression results as Table IV without control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B8: Reference Groups for Social Signaling

	Who is concerned about your child's vaccinations?				
Dependent Variable:	**Anyone concerned**	**Father of child**	**Family member**	**Nurse/CHW**	**Community member**
	(1)	(2)	(3)	(4)	(5)
Signal at 4	0.003	0.033	-0.004	-0.047	0.051
	(0.013)	(0.042)	(0.048)	(0.055)	(0.047)
Signal at 5	-0.033*	0.057	-0.010	-0.024	0.063
	(0.019)	(0.041)	(0.049)	(0.052)	(0.049)
Uninformative Bracelet	-0.003	0.050	-0.038	0.000	-0.000
	(0.015)	(0.042)	(0.047)	(0.058)	(0.051)
Control Group mean	0.974	0.583	0.624	0.382	0.272
Observations	1314	1314	1314	1314	1314
$S_4 > 0$: p(UI = S4)	0.688	0.684	0.513	0.439	0.352
$S_5 > 0$: p(UI = S5)	0.138	0.863	0.579	0.680	0.248
p(S4 = S5)	0.050	0.538	0.921	0.695	0.820
Joint F-Test	0.261	0.524	0.862	0.803	0.461

Notes: At endline respondents were asked "Is there anyone in your community or your house who is concerned about your child's immunization?". If a respondent answered "Yes", she was asked "Who will be concerned?". Each respondent was able to provide multiple reference groups. Column (1) is a binary indicator which is equal to one if a respondent confirmed that someone in her community is concerned about her child's immunization, and zero otherwise. Columns (2)-(5) display regression results for the different groups a respondent could subsequently mention. All regressions include strata-fixed effects and demeaned controls for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B9: Private and Social Benefits of Vaccination, Knowledge of Externalities

Dependent Variable:	**Vaccinations are helpful for my own child's health** (1)	**My child's vaccination can be helpful for other children in the community** (2)	**My child can be harmful to others if she/he is not immunized** (3)	**Other children can be harmful to my child if not immunized** (4)
Signal at 4	0.002	-0.030	-0.003	0.001
	(0.031)	(0.088)	(0.040)	(0.049)
Signal at 5	0.063**	-0.024	-0.073*	-0.060
	(0.027)	(0.084)	(0.038)	(0.043)
Uninformative Bracelet	-0.001	0.009	-0.034	-0.063
	(0.029)	(0.082)	(0.037)	(0.042)
Control Group mean	0.887	0.255	0.177	0.225
Observations	1314	1314	1314	1314
$S_4 > 0$: p(UI = S4)	0.938	0.606	0.339	0.121
$S_5 > 0$: p(UI = S5)	0.011	0.657	0.212	0.942
p(S4 = S5)	0.029	0.948	0.040	0.156
Joint F-Test	0.022	0.947	0.132	0.220
Controls	Yes	Yes	Yes	Yes

Notes: At endline respondents were asked, "Do you think that vaccination is helpful, harmful or both for your child?". Column (1) displays regression results where the outcome variable is binary and equal to one if the respondent said "Helpful" and zero if the respondent answered "Both, helpful and harmful" or "Harmful". Fewer than 1% of mothers said that vaccination is harmful to their child. Column (2)-(4) display respective survey questions, with the outcome being coded as one if answered "Yes", and zero otherwise. In the overall sample, 19.5% said that "their child can be harmful to others if she/he is not immunized", while 15% said that "other children can be harmful to my child if not immunized". I control for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. All regressions include strata-fixed effects. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B10: Others' Inferences about Types Conditional on Vaccination Decisions

Dependent Variable:	**Is anyone concerned about your child's immunization?**	**How would they view you if you missed to take your child for immunization?**					
		Careless	**Ignorant**	**Lazy**	**Busy**	**Poor**	**No judgement**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Signal at 4	0.003	0.005	-0.051	-0.015	-0.013	0.006	-0.004
	(0.013)	(0.019)	(0.032)	(0.011)	(0.013)	(0.005)	(0.012)
Signal at 5	-0.033*	-0.005	-0.047	-0.003	-0.019	0.010*	0.002
	(0.019)	(0.020)	(0.035)	(0.012)	(0.012)	(0.006)	(0.013)
Uninformative Bracelet	-0.003	-0.009	-0.015	-0.009	0.004	0.004	0.001
	(0.015)	(0.023)	(0.037)	(0.013)	(0.019)	(0.004)	(0.014)
Control Group mean	0.974	0.954	0.183	0.027	0.022	-0.000	0.021
Observations	1314	1270	1270	1270	1270	1270	1270
$S_4 > 0$: p(UI = S4)	0.688	0.543	0.292	0.646	0.345	0.739	0.712
$S_5 > 0$: p(UI = S5)	0.138	0.875	0.388	0.674	0.194	0.360	0.952
p(S4 = S5)	0.050	0.609	0.897	0.330	0.536	0.555	0.650
Joint F-Test	0.261	0.922	0.365	0.564	0.322	0.185	0.969

Notes: At endline respondents were asked, "Is there anyone in your community or your house who is concerned about your child's immunization?". If the respondent replied "Yes", she was asked "Who will be concerned?" and "How would these community members you named, view you the caregiver if you missed to take your child for immunization?". In this table, I summarize the results wherein I generate indicators which are equal to one if the respondent mentioned the respective answer, and zero otherwise. I then regress the binary outcome variable on the treatment indicator in a regression with demeaned control variables for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. All regressions include strata-fixed effects and standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B11: Inferences about Types Conditional on Vaccination Decisions

	How would community members view you if you... took your child for all vaccinations?		
Dependent Variable:	**Caring/patient/serious** (1)	**Know of importance** (2)	**Think nothing special about me** (3)
Signal at 4	-0.003	-0.032	-0.007
	(0.020)	(0.059)	(0.013)
Signal at 5	0.004	-0.044	-0.005
	(0.022)	(0.063)	(0.014)
Uninformative Bracelet	0.014	-0.025	-0.006
	(0.019)	(0.065)	(0.015)
Control Group mean	0.947	0.255	0.025
Observations	1270	1270	1270
$S_4 > 0$: p(UI = S4)	0.385	0.897	0.975
$S_5 > 0$: p(UI = S5)	0.642	0.746	0.942
p(S4 = S5)	0.728	0.828	0.905
Joint F-Test	0.833	0.912	0.959

Notes: At endline respondents were asked, "Is there anyone in your community or your house who is concerned about your child's immunization?". If the respondent answered "Yes", she was asked "Who will be concerned?" and "How would these community members view you if you missed to take your child for vaccinations? or ... took your child for all vaccinations?". I generate binary outcome variables, equal to one if the respondent named the respective answer, and zero otherwise. Regressions include strata-fixed effects and demeaned controls for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B12: The Combined Effects of Signals at 4 and 5 on Timely and Complete Vaccination, Separated by Treatment

Dependent variable:	**1 Vaccine** (1)	**2 Vaccines** (2)	**3 Vaccines** (3)	**4 Vaccines** (4)	**5 Vaccines** (5)	**Total # of vaccines** (6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4 and 5	0.001	0.020	0.040*	0.060*	0.066*	0.187*
	(0.007)	(0.013)	(0.023)	(0.033)	(0.038)	(0.103)
Uninformative Bracelet	0.007	0.016	0.027	0.020	0.027	0.097
	(0.007)	(0.012)	(0.024)	(0.036)	(0.043)	(0.108)
Distance	-0.003**	-0.009***	-0.017***	-0.026***	-0.029***	-0.083***
	(0.001)	(0.003)	(0.003)	(0.004)	(0.005)	(0.014)
Control Group mean	0.979	0.940	0.857	0.739	0.565	4.038
Observations	4897	4897	4897	4897	4897	4897
p(Signals = UI)	0.287	0.709	0.517	0.130	0.237	0.275
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4 and 5	0.002	0.009**	0.016**	0.026*	0.062**	0.116**
	(0.003)	(0.004)	(0.008)	(0.015)	(0.031)	(0.054)
Uninformative Bracelet	0.003	0.010***	0.011	0.008	0.028	0.060
	(0.003)	(0.004)	(0.008)	(0.017)	(0.035)	(0.059)
Distance	0.000	-0.000	-0.002**	-0.008***	-0.014***	-0.024***
	(0.000)	(0.001)	(0.001)	(0.002)	(0.004)	(0.006)
Control Group mean	0.993	0.984	0.959	0.917	0.686	4.539
Observations	4897	4897	4897	4897	4897	4897
p(Signals = UI)	0.415	0.843	0.418	0.168	0.205	0.195
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) through (5) of this table show results from a linear probability model of the binary outcome variable for a child being vaccinated for 1, 2, 3, 4, or 5 vaccinations on treatment indicators for Signal at 4 and 5 combined and Uninformative Bracelet, with the Control Group as the excluded category. Column (6) shows the results for the total number of vaccines a child has received. Panel A shows the results for timely vaccination by the age of 3, 4, 5, 6 and 11.5 months, respectively. For a child to be coded as timely for a given number of vaccines, they need to have been timely for all vaccines. Panel B shows the results for vaccination by the age of 12 months, simply counting the total number of vaccines a child has received. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signals at 4 and 5 (Signals), identifying social signaling preferences. Last is the joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned controls for distance to the clinic, clinic population size, a mother's ability to recall her child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B13: Effects of Signals on Timely Vaccination Using Different Cutoffs

Dependent variable:	**4 Vaccines**			**5 Vaccines**			
Age cutoff	4.5 months	5 months	6 months	10 months	11 months	11.5 months	12 months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Signal at 4	0.047	0.038	0.020	-0.009	-0.008	0.004	0.021
	(0.051)	(0.047)	(0.037)	(0.041)	(0.043)	(0.041)	(0.042)
Signal at 5	0.142***	0.126***	0.103***	0.123***	0.130***	0.133***	0.140***
	(0.047)	(0.045)	(0.035)	(0.042)	(0.041)	(0.041)	(0.042)
Uninformative Bracelet	0.065	0.052	0.021	0.039	0.030	0.028	0.038
	(0.050)	(0.046)	(0.036)	(0.043)	(0.043)	(0.043)	(0.042)
Distance	-0.031***	-0.033***	-0.027***	-0.029***	-0.029***	-0.030***	-0.029***
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Control Group mean	0.500	0.606	0.740	0.445	0.552	0.567	0.584
Observations	4897	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.695	0.706	0.989	0.173	0.281	0.487	0.620
$S_5 > 0$: p(UI = S5)	0.065	0.046	0.004	0.033	0.007	0.004	0.005
p(S4 = S5)	0.024	0.015	0.004	0.000	0.000	0.000	0.000
Joint F-Test	0.011	0.014	0.002	0.001	0.000	0.000	0.001
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the same regressions for four and five vaccines as in Panel A of Table IV, using different timeliness cut-offs. For four vaccines, I show results by age 4.5, 5, and 6 months. For five vaccines by 10, 11, 11.5, and 12 months of age. I regress the binary outcome variable on a treatment indicator for Signal at 4 and 5, with the omitted category being the Control Group. All regressions include strata-fixed effects and demeaned controls for distance to the clinic, clinic population size, a mother's ability to recall her child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B14: Effects of Signals on Timely- and Complete Vaccination by Age One Year (Variable Sample)

Dependent variable:	**1 Vaccine** (1)	**2 Vaccines** (2)	**3 Vaccines** (3)	**4 Vaccines** (4)	**5 Vaccines** (5)	**Total # of vaccines** (6)
Panel A:			Effects of Signals on Timely Vaccination			
Signal at 4	-0.006	0.011	0.004	0.016	0.001	0.031
	(0.009)	(0.014)	(0.025)	(0.037)	(0.041)	(0.114)
Signal at 5	0.014*	0.041***	0.074***	0.111***	0.130***	0.350***
	(0.008)	(0.013)	(0.023)	(0.034)	(0.040)	(0.106)
Uninformative Bracelet	0.008	0.021*	0.022	0.019	0.028	0.104
	(0.007)	(0.012)	(0.023)	(0.035)	(0.043)	(0.107)
Control Group mean	0.972	0.927	0.846	0.714	0.557	4.021
Observations	6569	6354	6143	5909	4923	4923
$S_4 > 0$: p(UI = S4)	0.064	0.346	0.378	0.904	0.440	0.433
$S_5 > 0$: p(UI = S5)	0.376	0.025	0.006	0.002	0.006	0.005
p(S4 = S5)	0.017	0.002	0.000	0.001	0.000	0.000
Joint F-Test	0.060	0.001	0.000	0.000	0.000	0.000
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B:			Effects of Signals on Vaccination by Age One Year			
Signal at 4	0.002	0.009**	0.013	0.019	0.033	0.075
	(0.003)	(0.004)	(0.009)	(0.017)	(0.033)	(0.057)
Signal at 5	0.002	0.009**	0.019**	0.035**	0.094***	0.159***
	(0.003)	(0.004)	(0.008)	(0.016)	(0.033)	(0.057)
Uninformative Bracelet	0.003	0.010***	0.011	0.008	0.029	0.061
	(0.003)	(0.004)	(0.008)	(0.017)	(0.035)	(0.059)
Control Group mean	0.993	0.984	0.959	0.917	0.687	4.541
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.499	0.804	0.807	0.445	0.890	0.754
$S_5 > 0$: p(UI = S5)	0.547	0.950	0.225	0.075	0.031	0.039
p(S4 = S5)	0.971	0.863	0.328	0.172	0.017	0.033
Joint F-Test	0.575	0.055	0.132	0.132	0.016	0.019
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the same regression results as in Table IV, using a variable sample of all children old enough to be assessed as timely or late for a given number of vaccines. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B15: Effects of Signals on Timely- and Complete Vaccination by Age One Year (without Controls)

Dependent variable:	**1 Vaccine**	**2 Vaccines**	**3 Vaccines**	**4 Vaccines**	**5 Vaccines**	**Total # of vaccines**
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4	-0.005	0.008	0.008	0.015	-0.006	0.019
	(0.008)	(0.013)	(0.024)	(0.036)	(0.040)	(0.110)
Signal at 5	0.007	0.031**	0.069***	0.098***	0.127***	0.335***
	(0.007)	(0.013)	(0.024)	(0.035)	(0.041)	(0.107)
Uninformative Bracelet	0.006	0.014	0.026	0.019	0.028	0.092
	(0.007)	(0.013)	(0.025)	(0.036)	(0.043)	(0.110)
Control Group mean	0.979	0.940	0.859	0.745	0.576	4.049
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.112	0.501	0.378	0.903	0.298	0.392
$S_5 > 0$: p(UI = S5)	0.915	0.056	0.029	0.004	0.005	0.004
p(S4 = S5)	0.087	0.009	0.001	0.002	0.000	0.000
Joint F-Test	0.288	0.015	0.003	0.002	0.000	0.000
Controls	No	No	No	No	No	No
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4	0.002	0.008**	0.011	0.013	0.021	0.054
	(0.003)	(0.004)	(0.008)	(0.016)	(0.033)	(0.057)
Signal at 5	0.001	0.009**	0.018**	0.032*	0.091***	0.150***
	(0.003)	(0.004)	(0.008)	(0.017)	(0.034)	(0.058)
Uninformative Bracelet	0.002	0.009**	0.011	0.008	0.033	0.064
	(0.002)	(0.004)	(0.008)	(0.019)	(0.037)	(0.063)
Control Group mean	0.990	0.981	0.958	0.918	0.700	4.546
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.661	0.852	0.887	0.745	0.644	0.811
$S_5 > 0$: p(UI = S5)	0.571	0.936	0.285	0.093	0.041	0.051
p(S4 = S5)	0.877	0.925	0.219	0.086	0.005	0.011
Joint F-Test	0.758	0.099	0.172	0.145	0.012	0.018
Controls	No	No	No	No	No	No

Notes: This table shows the same regression results as in Table IV, without control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B16: The Effect of Signals on Timely Vaccination, Separate by Treatment (non-absorbing definition; with controls)

Dependent variable:	**Vaccine 1** (1)	**Vaccine 2** (2)	**Vaccine 3** (3)	**Vaccine 4** (4)	**Vaccine 5** (5)	**Total # of vaccines** (6)
Signal at 4	-0.005	0.009	0.016	0.024	0.015	0.080
	(0.009)	(0.012)	(0.023)	(0.034)	(0.033)	(0.080)
Signal at 5	0.008	0.032***	0.072***	0.092***	0.087***	0.213***
	(0.007)	(0.011)	(0.022)	(0.031)	(0.033)	(0.076)
Uninformative Bracelet	0.008	0.013	0.031	0.015	0.018	0.064
	(0.007)	(0.011)	(0.022)	(0.033)	(0.036)	(0.081)
Distance	-0.003**	-0.006***	-0.015***	-0.024***	-0.016***	-0.039***
	(0.001)	(0.002)	(0.003)	(0.004)	(0.004)	(0.009)
Control Group mean	0.979	0.950	0.871	0.772	0.663	4.347
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.097	0.719	0.438	0.777	0.922	0.795
$S_5 > 0$: p(UI = S5)	0.980	0.013	0.026	0.004	0.024	0.016
p(S4 = S5)	0.075	0.008	0.002	0.009	0.004	0.011
Joint F-Test	0.220	0.003	0.002	0.003	0.010	0.006
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the same regression results as in Panel A of Table IV, but timeliness for each vaccine is assessed independently from timeliness of previous vaccines. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B17: Additional Information on Bracelet Retention and Correct Hand Out

Dependent variable:	**Child wears bracelet**	**Bracelet was exchanged**	**Child lost bracelet**		
			Full Sample	3.5-6.5 months	9-12 months
	(1)	(2)	(3)	(4)	(5)
Signal at 4	-0.067	0.033	0.024	0.064	0.031
	(0.062)	(0.073)	(0.047)	(0.059)	(0.080)
Signal at 5	-0.018	-0.083	-0.080*	-0.051	-0.151**
	(0.059)	(0.068)	(0.041)	(0.048)	(0.072)
Uninformative Bracelet mean	0.397	0.633	0.213	0.124	0.319
Observations	3278	613	803	250	283
p(S4 = S5)	0.451	0.125	0.002	0.014	0.007

Notes: This table shows results from a linear probability model of the binary outcome variables for a child wearing a bracelet during the listing survey (column 1), whether a child's bracelet was exchanged when she came for vaccine 4 or 5 (column 2), and whether a child had lost her bracelet at endline (column 3-4), on Signal at 4 and Signal at 5 treatment indicators, with the Uninformative Bracelet as the omitted category. Column (1) includes children that were born during the experiment, surveyed during the listing, and for whom surveyors could see the wrist during the survey. The sample used in column (2) further conditions on a child having received four or five vaccines (as otherwise the child would not have been eligible for an exchange of the bracelet). The sample used in columns (3)-(5) includes all children whose mothers were surveyed in the bracelet treatments at endline. The sample used in columns (4) and (5) includes children 3.5 to 6.5 and 9 to 12 months old, as these are the ages at which children are eligible for signaling bracelet in Signal at 4 and Signal at 5, respectively. When asking parents during endline, why the child is not wearing the bracelet, the most common answer was that they are afraid of the child losing the bracelet by biting on it or playing with it. Parents further report that the child wears the bracelet when going to the clinic or on special occasions, when visiting relatives or at community events. All regressions include strata-fixed effects. Standard errors are clustered bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B18: Aggregate Beliefs

Dependent variable:	**Vaccine 1** (1)	**Vaccine 2** (2)	**Vaccine 3** (3)	**Vaccine 4** (4)	**Vaccine 5** (5)
Signal at 4	0.213	0.495*	0.425	0.463	0.442
	(0.239)	(0.272)	(0.277)	(0.285)	(0.318)
Signal at 5	0.279	0.515*	0.505*	0.355	0.453
	(0.244)	(0.272)	(0.291)	(0.298)	(0.328)
Uninformative Bracelet	-0.115	0.158	0.279	0.153	0.237
	(0.263)	(0.303)	(0.283)	(0.295)	(0.307)
Control Group mean	8.991	7.783	7.022	6.454	5.547
Observations	1255	1255	1255	1255	1255
$S_4 > 0$: p(UI = S4)	0.111	0.201	0.581	0.298	0.528
$S_5 > 0$: p(UI = S5)	0.054	0.162	0.410	0.513	0.513
p(S4 = S5)	0.690	0.923	0.753	0.703	0.973
Joint F-Test	0.226	0.163	0.331	0.397	0.450
Controls	Yes	Yes	Yes	Yes	Yes

Notes: This table shows endline respondents' beliefs ($N = 1,255$) about how many out of 10 community members take their child for immunization at the clinic, for a given number of vaccinations. The sample excludes answers of 59 respondents who did not understand the question. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or of Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to the effect of Signal at 5. The last row is a joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned controls for the age of the mother, whether her primary economic activity is farming, her level of education, as well as the birth order of the child. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B19: Correlation of Distance and Socio-Economic Characteristics

Dependent variable:	**3 Vaccines** (1)	**4 Vaccines** (2)	**5 Vaccines** (3)	**3 Vaccines** (4)	**4 Vaccines** (5)	**5 Vaccines** (6)
Distance 1 mile	0.034	0.003	-0.019	0.052	0.023	-0.015
	(0.048)	(0.054)	(0.069)	(0.048)	(0.051)	(0.069)
Distance 2 miles	-0.043	-0.070	-0.109	-0.041	-0.066	-0.109
	(0.045)	(0.058)	(0.071)	(0.042)	(0.053)	(0.071)
Distance 3 miles	-0.015	-0.035	-0.084*	-0.022	-0.042	-0.076
	(0.032)	(0.036)	(0.047)	(0.032)	(0.035)	(0.048)
Distance 4 miles	-0.024	-0.052	-0.125*	-0.019	-0.049	-0.126*
	(0.046)	(0.051)	(0.068)	(0.042)	(0.046)	(0.066)
Distance 5 miles	-0.130**	-0.157**	-0.129*	-0.132**	-0.165***	-0.132*
	(0.057)	(0.068)	(0.072)	(0.053)	(0.061)	(0.076)
Child age				0.000***	0.000***	0.000
				(0.000)	(0.000)	(0.000)
Birth order				-0.017	-0.035**	-0.035*
				(0.013)	(0.015)	(0.021)
Mother age				-0.000	0.002	0.005
				(0.003)	(0.003)	(0.004)
Floor cement				0.050**	0.063**	0.068
				(0.025)	(0.029)	(0.042)
Roof corrugated iron				-0.046	-0.040	0.029
				(0.037)	(0.051)	(0.063)
Has any education				0.021	0.029	0.067**
				(0.018)	(0.021)	(0.028)
Works on farm				0.078*	0.095*	0.078
				(0.045)	(0.054)	(0.091)
Trader				0.065	0.041	0.034
				(0.045)	(0.060)	(0.095)
Constant	0.837***	0.765***	0.755***	0.681***	0.521***	0.506***
	(0.027)	(0.028)	(0.033)	(0.094)	(0.112)	(0.147)
Outcome Mean	0.837	0.765	0.755	0.681	0.521	0.506
Observations	1101	1033	668	1101	1033	668

Notes: This table shows the effect of distance on timely completion of 3, 4, and 5 vaccines comparing treatment effects from regressions without and with covariates. The sample includes all children (age 4 months and above, to be counted for vaccine 3 etc.) whose parents were surveyed at endline and for whom I therefore observe socio-economic characteristics. Columns (1)-(3) show regression results without covariates, and columns (4)-(6) results with covariates. The covariate child age is coded in days, mother age in years; the variable birth order takes values 1 through 6. The variables Floor cement, Roof corrugated iron, Has any education, Works on farm and Trader are indicator variables that take value one if the respondent's floor is made of cement etc. and zero otherwise. The distance variable takes the values zero to five miles. All regressions include strata-fixed effects. Standard errors are clustered at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B20: Test of the Equality of Distance Coefficients from Table B19

	Distance 1 mile	**2 miles**	**3 miles**	**4 miles**	**5 miles**
	(1)	(2)	(3)	(4)	(5)
5 Vaccines	-0.007	0.000	-0.012	0.000	0.004
	(0.016)	(0.014)	(0.012)	(0.017)	(0.015)
Observations	668	668	668	668	668
4 Vaccines	0.007	0.006	-0.002	0.006	0.000
	(0.007)	(0.008)	(0.008)	(0.010)	(0.010)
Observations	1033	1033	1033	1033	1033
3 Vaccines	0.002	0.001	-0.004	-0.002	-0.002
	(0.005)	(0.006)	(0.006)	(0.008)	(0.007)
Observations	1101	1101	1101	1101	1101

Notes: This table tests for the equality of the coefficients from the regressions of 3, 4, and 5 vaccines on distance dummy variables with and without covariates (see B19), using seemingly-unrelated estimation. The table displays the difference in coefficients and associated p-values. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B21: Cost-effectiveness of Interventions to Increase Childhood Vaccination

Intervention	Cost-effectiveness	Country	Baseline full immunization rates	All Program Costs	Digital Registry Costs	Government Costs and Benefits	Recipients Incentives Benefits and Costs
Signaling Bracelets	$24.7	Sierra Leone	69%	✓	NA	×	✓
SMS Reminders + Mobile Incentive (Gibson et al. 2017)	$90	Kenya	82%	×	×	×	×
Mobile Incentives (Chandir et al. 2022)	$23	Pakistan	56%	✓	×	✓	✓
In-kind Incentives (Banerjee et al. 2010)	$27.9	India	18%	✓	NA	×	×
Immunization Ambassadors + SMS Reminders (Banerjee et al. 2021)	$21	India	39%	✓	✓	✓	×

Notes: This table presents studies that estimate the cost-effectiveness of interventions to increase childhood vaccination, summarizing their main results and key inputs. These studies were selected for their focus on popular interventions, availability of cost data, and being peer-reviewed. For each study reporting multiple cost-effectiveness estimates, I selected the most rigorously derived estimate. Program cost typically include the cost of the incentive or message, and the cost of administering the program, such as transfer costs. Government costs and benefits are marked as included when authors calculated the intervention's cost-effectiveness from the government's perspective, incorporating the costs of vaccine administration. Costs and benefits to the recipients cover parents' time and opportunity costs, and direct benefits from the incentives.

The participant costs for the signaling bracelets are based on parental data on travel time to the clinic, an estimated 30-minute wait at the clinic, as well as transportation costs and informal fees paid to the nurse (see Table B1) for all vaccination visits. The value of time is calculated using the unskilled daily wage in Sierra Leone in 2019.[a]

[a] Global Wage Report 2020–21: Wages and minimum wages in the time of COVID-19 International Labour Office – Geneva: ILO, 2020.

Table B22: The Effects of Signals on Timely and Complete Vaccination, Separated by Treatment (No Bootstrapping)

Dependent variable:	**1 Vaccine**	**2 Vaccines**	**3 Vaccines**	**4 Vaccines**	**5 Vaccines**	**Total # of vaccines**
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4	-0.005	0.007	0.009	0.020	0.004	0.035
	(0.008)	(0.013)	(0.023)	(0.035)	(0.038)	(0.106)
Signal at 5	0.008	0.033***	0.072***	0.103***	0.133***	0.351***
	(0.007)	(0.012)	(0.023)	(0.032)	(0.038)	(0.100)
Uninformative Bracelet	0.008	0.017	0.028	0.021	0.028	0.100
	(0.006)	(0.011)	(0.022)	(0.033)	(0.040)	(0.099)
Distance	-0.003**	-0.009***	-0.017***	-0.027***	-0.030***	-0.086***
	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.014)
Control Group mean	0.979	0.940	0.858	0.740	0.567	4.042
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.067	0.323	0.329	0.988	0.455	0.451
$S_5 > 0$: p(UI = S5)	0.979	0.035	0.017	0.002	0.002	0.002
p(S4 = S5)	0.058	0.004	0.001	0.003	0.000	0.000
Joint F-Test	0.162	0.005	0.002	0.001	0.000	0.000
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4	0.002	0.009**	0.013	0.019	0.033	0.076
	(0.003)	(0.004)	(0.008)	(0.016)	(0.032)	(0.055)
Signal at 5	0.002	0.009**	0.019**	0.035**	0.094***	0.159***
	(0.003)	(0.004)	(0.007)	(0.015)	(0.031)	(0.053)
Uninformative Bracelet	0.003	0.010***	0.011	0.008	0.029	0.061
	(0.002)	(0.003)	(0.007)	(0.016)	(0.033)	(0.056)
Distance	0.000	-0.000	-0.002**	-0.008***	-0.015***	-0.025***
	(0.000)	(0.001)	(0.001)	(0.002)	(0.004)	(0.006)
Control Group mean	0.993	0.984	0.959	0.917	0.687	4.541
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.443	0.776	0.793	0.435	0.882	0.742
$S_5 > 0$: p(UI = S5)	0.504	0.942	0.189	0.060	0.015	0.024
p(S4 = S5)	0.967	0.842	0.265	0.124	0.007	0.015
Joint F-Test	0.501	0.036	0.085	0.083	0.006	0.007
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) through (5) of this table show results from a linear probability model of the binary outcome variable for a child being vaccinated for 1, 2, 3, 4, or 5 vaccinations on treatment indicators for Signal at 4, Signal at 5 and Uninformative Bracelet, with the Control Group as the excluded category. Column (6) shows the results for the total number of vaccines a child has received. Panel A shows the results for timely vaccination by the age of 3, 4, 5, 6 and 11.5 months, respectively. For a child to be coded as timely for a given number of vaccines, they need to have been timely for all those vaccines. Panel B shows the results for vaccination by the age of 12 months, counting the total number of vaccines a child has received. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), identifying social signaling preferences, and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned controls for distance to the clinic, clinic population size, a mother's ability to recall her child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey. Standard errors are clustered at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B23: The Effects of Signals on Complete Vaccination by 12, 18, and 24 months (No bootstrapping)

Dependent variable:		**4 Vaccines**			**5 Vaccines**	
	by 12 months	by 18 months	by 24 months	by 12 months	by 18 months	by 24 months
	(1)	(2)	(3)	(4)	(5)	(6)
Signal at 4	0.012	0.013	0.017	0.024	0.028	0.034
	(0.017)	(0.014)	(0.013)	(0.037)	(0.029)	(0.030)
Signal at 5	0.028*	0.021*	0.023*	0.085**	0.061**	0.051*
	(0.016)	(0.013)	(0.012)	(0.038)	(0.029)	(0.028)
Uninformative Bracelet	-0.009	-0.003	-0.004	0.010	0.013	0.021
	(0.019)	(0.015)	(0.015)	(0.039)	(0.031)	(0.028)
Control Group mean	0.936	0.951	0.952	0.736	0.828	0.848
Observations	3040	3040	3040	3040	3040	3040
$S_4 > 0$: p(UI = S4)	0.264	0.273	0.114	0.667	0.613	0.620
$S_5 > 0$: p(UI = S5)	0.035	0.080	0.038	0.023	0.105	0.255
p(S4 = S5)	0.170	0.348	0.459	0.023	0.166	0.500
Joint F-Test	0.115	0.221	0.113	0.036	0.160	0.350
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows results from a linear probability model with binary outcome variables for a child being vaccinated for four or five vaccines by 12, 18, or 24 months on a treatment indicator for Signal at 4, Signal at 5 and Uninformative Bracelet with the omitted category being the Control Group. Each vaccine outcome is coded one if a child completed 4 or 5 vaccines, by ages 12, 18, or 24 months, and zero otherwise. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. All regressions include the distance from the community to the clinic, the clinic population size, and a mother's ability to recall her child's last vaccine. Regressions include strata-fixed effects and standard errors are clustered at the clinic-level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C Additional Information on Sampling

Sampling of Endline Respondents

I used the listing data of 14,061 children as the sampling frame for the endline survey. Before randomly drawing the mothers to be surveyed, I refined the sample by excluding:

- Children who had permanently moved, were traveling at the time of the listing exercise and not present in the community, or had died ($N = 1,975$).
- Children who did not attend a study clinic for immunization services. This applied to communities with multiple accessible clinics at similar walking distances, where mothers typically chose the clinic where they had received prenatal care ($N = 1,330$).
- Children born before January 1, 2017, i.e., before the start of the experiment in all 120 clinics, and before all selected communities had been visited for informational meetings ($N = 4,812$).
- Communities with fewer than three babies ($N = 127$).

This resulted in a final sample of 5,817 children across 490 communities. I then implemented a two-stage randomization: First, I randomly selected four communities for each clinic, stratified by distance, comprising two close and two far communities. Some clinics had fewer than four communities, leading to a total of 401 communities, with 205 close and 196 far communities across 120 clinics. Second, I randomly drew 10 mothers from the close communities and 10 mothers from the far communities for each clinic (i.e. 20 mothers per clinic). From these ten mothers, I randomly selected six for the survey and four as replacements in case a mother could not be found, had moved, or was deceased. In total 1,323 mothers across 383 communities were surveyed at endline, averaging 11 respondents per clinic, balanced across arms. I exclude one clinic in Western Area Rural from my analysis due to serious implementation issues, resulting in a final endline sample of 1,314 respondents.

Follow-up Sample Attrition

I test for differences in vaccination behavior between children who attrited at follow-up and those successfully resurveyed by examining their vaccination outcomes for vaccines one through four at the time of the listing, when both groups were observed. If children who are less responsive to the bracelet incentives are more likely to attrit, my treatment effect estimates would be biased upwards. The results in Table C1 suggest that this concern is unwarranted. Control Group children who were found at follow-up are, on average, more likely to be vaccinated on time for one, two and four vaccines, compared to those who attrited. However, there are no significant differences in treatment effects between found and attrited children for Signal at 4 and the Uninformative Bracelet. For Signal at 5, treatment effects for children who were found are slightly smaller compared to those who attrited for one and two vaccines, suggesting that attrition, if anything, would lead me to finding smaller impacts for Signal at 5.

Table C1: Differences in vaccination outcomes between attrited and non-attrited children at the time of the listing

Dependent variable:	**1 Vaccine** (1)	**2 Vaccines** (2)	**3 Vaccines** (3)	**4 Vaccines** (4)
Found	0.035**	0.055**	0.018	0.080*
	(0.014)	(0.022)	(0.032)	(0.045)
Uninformative Bracelet	-0.012	0.017	-0.009	0.011
	(0.017)	(0.030)	(0.044)	(0.053)
Signal at 4	-0.011	0.008	-0.013	0.001
	(0.019)	(0.030)	(0.042)	(0.056)
Signal at 5	0.020	0.051*	0.067	0.134**
	(0.017)	(0.029)	(0.041)	(0.055)
Found × Uninformative Bracelet	0.003	-0.017	0.056	-0.029
	(0.019)	(0.033)	(0.051)	(0.064)
Found × Signal at 4	-0.013	-0.008	0.051	0.022
	(0.019)	(0.027)	(0.043)	(0.064)
Found × Signal at 5	-0.042**	-0.050*	0.001	-0.032
	(0.019)	(0.030)	(0.048)	(0.062)
Control Group Mean	0.954	0.884	0.791	0.600
Observations	3462	2914	2443	1933

Notes: This table shows results from a linear probability model of a binary outcome variable for a child being vaccinated timely for 1, 2, 3, or 4 vaccinations on the interaction between a binary indicator that is one if the child was found and surveyed at follow-up, and zero otherwise (i.e. if moved or traveled, deceased or not found). Among the 5,030 children that were followed up, 3,462 children were 3 months or older during the listing survey and I observe their vaccination outcomes. Standard errors are clustered at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D Conceptual Framework

I adapt Bursztyn and Jensen's (2017) simplified framework of social signaling and augment it to include uncertainty about future cost.[42] The model discussion serves two purposes: first, it details the main objects that I consider when introducing experimental variation and analyzing results; second, it states predictions based on social signaling preferences in a dynamic setting.

D.1 Social Signaling with Uncertainty

There are five vaccinations and in each period $t \in \{1, 2, 3, 4, 5\}$ a parent i decides whether to complete period t vaccine. A vaccination is considered completed on time if it is taken in period t and previous vaccines were also completed on time, so that parents are effectively choosing a stopping point $a_i \in \{0, 1, 2, 3, 4, 5\}$. Taking a vaccine late or missing it altogether is an absorbing state. This maps onto the main empirical exercise, where I commonly focus on the number of vaccines a child has taken on time.

Parents differ in their intrinsic motivation to look after their child's health, defined by their type $\upsilon_i \in \{l, h\}$, which is private information. Parents receive a private benefit $b(t; \upsilon_i)$ from the period t vaccine, which is a function of her type.[43] Without loss of generality, I assume that higher types h receive greater utility from vaccinating and therefore are more likely to vaccinate their child on time than low type l parents.[44] Hence, the action of vaccinating one's child reveals information about a parent's type. In each period, a parent also faces a cost $c(t)$ that comprises a time-varying component, common to all parents (e.g., travel and mental effort cost), and a random component ϵ_t, which is known only at time t when deciding whether to take a child for the next vaccine. This uncertainty rationalizes the fact that some parents intend to vaccinate their child for all vaccines but stop early, and that parents consider uncertainty over future cost when deciding to vaccinate in the current period.

The key part of the model are the social image benefits and costs associated with the expectations that others, indexed by $-i$, will form about i's type as actions become visible. The signaling treatments in my experiment aim to increase the probability $Pr_{-i}(a_i \geq r | a_i \geq r)$ that a parent believes that others know if their child completed at least $r \in \{4, 5\}$ vaccinations and update their expectations about their type, that is, $Pr_{-i}(\upsilon_i = h | a_i \geq r)$. The parameter λ measures how much parents care about being perceived as type h, which I assume is constant across different actions.[45] Taken together, i's utility in every period t can be described by:

$$\begin{aligned} \text{if vaccinate} \quad & u_t^v = b(t; \upsilon_i) - c(t) + \lambda Pr_{-i}(\upsilon_i = h | a_i \geq r) \cdot \mathbb{1}\{t = r\} \\ \text{if stop vaccinating} \quad & u_t^{nv} = \lambda Pr_{-i}(\upsilon_i = h | a_i < r) \cdot \mathbb{1}\{t = r\} \end{aligned}$$

This gives the value function for a parent who has stopped vaccinating: $V_t^{nv} = \Sigma_\tau^5 u_\tau^{nv}$. For a parent who has not yet stopped vaccinating, the value function is $V_t^v = u_t^v +$

[42] The authors adapt Bénabou and Tirole's (2006) theoretical framework of social signaling.

[43] I abstract from the externality benefits of vaccination since individuals in the context of my study predominantly think of vaccinations as a private good and lack an understanding of their societal benefits.

[44] While I lack the survey data to verify this single-crossing condition assumption, parents' beliefs about how others perceive them–based on whether they vaccinate their child or not–align with the type distinction of being "caring" versus "negligent".

[45] Following the literature, I assume that $\lambda \geq 0$, as parents generally would like to be perceived as caring and responsible, rather than careless and negligent, towards their children.

$\max\{V_{t+1}^{nv}, V_{t+1}^{v}\}$ for $t < 5$ and $V_5^v = u_5^v$ for $t = 5$. The decision-problem is solved by backward recursion, with parents optimally deciding in each period according to the decision-rule: vaccinate if $V_t^v > V_t^{nv}$, and stop otherwise.

D.2 Testable Assumptions of Social Signaling

There are three main assumptions necessary for an increase in the visibility of vaccinations to impact behavior. I empirically verify these in Section IV. First, parents must believe that others have imperfect information about their children's vaccinations. Second, as the observability of vaccinations increases, parents must believe that others are more likely to correctly infer their actions, meaning the probability that others correctly assume a child has been vaccinated when they have been (denoted as $Pr_{-i}(a_i \geq r | a_i \geq r)$) is greater than if they had not been (denoted as $Pr_{-i}(a_i \geq r | a_i < r)$). Third, parents must believe that others will form expectations about their type υ_i based on the observed actions, meaning the probability that others consider them as a high type given their actions are observed as $a \geq r$ is higher than if their actions are observed as $a < r$.

D.3 Predictions for Vaccination Behavior

Based on these assumptions, I explore three intuitive predictions in Section Section V. First, as visibility increases parents are more likely to vaccinate their child on time for at least r vaccines, if they value others' perceptions of their type ($\lambda > 0$). Second, parents are more likely to complete earlier vaccines in a timely manner. Parents choose to do so if the option value of signaling is sufficiently large for them to expect to vaccinate in a timely manner up to r, but will stop before if they receive a too negative cost shock. Third, if the signaling threshold is set at four vaccines (i.e., $r = 4$) parents are also more likely to complete five vaccines in a timely manner. Some parents who vaccinate up to four vaccines, receive a positive cost shock at $t = 5$, which makes it beneficial for them to continue vaccinating.

The model's assumptions, its mechanism, and the main predictions it generates about parents' decision-making regarding the number of vaccines a remain the same regardless of timeliness.

E Structural Model Estimation of Social Signaling Utility

To quantify the value of social signaling while accounting for i) the dynamic nature of decision-making, in which parents respond to the option value of social signaling, and ii) the effects of type selection at later vaccines, I estimate a dynamic discrete-choice model. Following the discussion of the model of signaling under uncertainty in Appendix D, I empirically specify the flow utility of timely vaccination at time $t \in \{1, 2, 3, 4, 5\}$:

$$u_{it} = \upsilon_i - \kappa D_i - \eta_t + S_4 T_{4i} \mathbb{1}\{t = 4\} + S_5 T_{5i} \mathbb{1}\{t = 5\} + \epsilon_{it}. \tag{1}$$

The model includes two dimensions of unobservable heterogeneity: (i) ϵ_{it}, representing cost or taste shocks that follow a logistic distribution and are independent and identically distributed, and (ii) individuals' type υ, which is assumed to be drawn from a normal distribution at period zero and remains persistent across time t. The type distribution's mean μ_υ and variance σ_υ are identified in the structural estimation, as individuals' decisions are observed over multiple periods.

Additionally, the model includes two dimensions of observable heterogeneity: (i) individuals' travel distance to the clinic D_i, which varyies discretely from zero to five miles, and (ii) the signaling treatments T_{4i} and T_{5i}, assigned exogenously. The parameter κ captures the marginal disutility of traveling one additional mile to the clinic. The parameters S_4 and S_5 quantify the social signaling utility, expressed as $\lambda(Pr_{-i}(\upsilon_i = h|a \geq r)$ - $Pr_{-i}(\upsilon_i = h|a < r))$. The disutility of receiving a vaccine in period t is denoted by η_t. To reflect the relative importance individuals assign to different vaccines, as reported in Table VI, η_t is set such that its relative size compared to $\eta_{t'}$ for $t' \neq t$ aligns with the reported levels: $\eta_t = \alpha \mathbb{1}(t = 2) - 3\alpha \mathbb{1}(t = 3) - 4\alpha \mathbb{1}(t = 4) - \alpha \mathbb{1}(t = 5)$.

The reduced form effects of the Signal at 5 treatment on earlier vaccines operate solely through an option value, which depends on individuals' expectations about the likelihood of achieving the signaling payoff by vaccinating on time for all vaccines. At $t = 5$, there is no option value component left and the problem becomes a static one that can be solved through backward recursion. However, the valuation is that of a non-random subset of individuals, not the type population as a whole. To derive the signaling valuation from the reduced form, it is necessary to integrate all the choice probabilities and treatment effects across time, accounting for the changing composition of the type population at each t. The structural framework allows for this integration, and I estimate the model using maximum likelihood.

Table E1 displays the structural estimation results. Column 1 shows the parameters from an estimation comparing the shares of children vaccinated on time in Signal at 5 and Signal at 4 to those in the Control Group, while Column 2 compares both signaling treatments to the Uninformative Bracelet. The ratio of the parameters S_5 and κ gives an estimate of the social signaling utility in miles. Parents, on average, value social signaling as equivalent to walking 6 to 7 miles to the clinic. This implies that, for an average walking distance of 2 miles to the clinic, the opportunity to signal timely vaccine completion motivates parents to undertake the equivalent of three additional vaccinations.

Table E1: Structural Estimation Results Dynamic Discrete-Choice Model

Parameter:	**Estimate**	**SE**	**Estimate**	**SE**
	Compared to Control Group		Compared to Uninformative Bracelet	
	(1)	(2)	(3)	(4)
S_5	0.642	0.098	0.498	0.098
S_4	–0.027	0.111	–0.196	0.113
κ	–0.09	0.012	–0.085	0.012
μ_υ	1.801	0.078	1.893	0.081
σ_υ	–0.49	0.067	–0.475	0.068
α	–0.259	0.028	–0.265	0.029
Signaling utility $\frac{S_5}{\kappa}$	**7.13 miles**		**5.86 miles**	

Notes: This table shows the parameters estimated from the dynamic-discrete choice model. S_5 and S_4 denote the parameters capturing the signaling utility of treatments Signal at 5 and Signal at 4, κ denotes the parameter measuring the marginal disutility of walking one mile, μ_υ and σ_υ capture the mean and standard deviation of the normal type distribution. The sample used for the estimation is the main analysis sample. Regular standard errors are reported (not clustered). Columns (1) and (2) report parameter estimates, with the effect of Signals at 4 and 5 being compared to the Control Group and Columns (3) and (4) from the comparison to the Uninformative Bracelet.

F Implementation Materials

Social Incentives for Child Immunization

Instruction and messaging card

Give out bracelets to babies that are 15 months or younger and come for immunization.

Schedule	Bracelet type	Comment
Hand out BRACELET at **1^{st} visit: BCG**	**1^{st} visit** **1^{st} visit**	**Give YELLOW OR GREEN BRACELET** to EVERY CHILD that comes OR already came for **1^{st} vaccine visit.** Allow the caregiver to choose the preferred color.
Exchange BRACELET at: **4^{th} and 5^{th} visits:** **- Penta3** **- Measles I**	**1^{st} visit** **1^{st} visit**	**EXCHANGE the previous BRACELET for a NEW ONE of the SAME color at EACH of the 4^{th} and 5^{th} vaccine visit.**

Please give the following messages to the caregiver.

Show the bracelets to the caregiver and say – we give the YELLOW or GREEN bracelet for the 1^{st} vaccine visit. The bracelets have 1^{st} visit written on them.

YELLOW or GREEN BRACELET – FOR 1^{st} vaccine visit

At BCG	• I give you the YELLOW / GREEN bracelet because you came for 1^{st} vaccine visit. • When you come onto the 4^{th} and 5^{th} vaccine visit I will exchange the bracelet to a NEW one of the same color.
At Penta1, Penta2, Penta3, Measles I or II	• I give you the YELLOW / GREEN bracelet **not** because of this visit but because you came for 1^{st} vaccine visit. • When you come onto the 4^{th} and 5^{th} vaccine visit I will exchange the bracelet to a NEW one of the same color.

YELLOW or GREEN BRACELET – FOR EXCHANGE at 4^{th} or 5^{th} vaccine visit

At Penta3, Measles I	• I exchange your bracelet to a new one of the same color because you came for the 4^{th} / 5^{th} vaccine visit.

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Figure F1: Clinic Staff Messaging Cards, Uninformative Bracelet

Social Incentives for Child Immunization

Messaging card

Please give the following messages to caregivers.

Show the bracelets to the caregivers and say – we give the YELLOW bracelet for the 1^{st} vaccine visit; we give the GREEN bracelet to a child that comes TIMELY for 4^{th} vaccine visit. The bracelets have 1^{st} and 4^{th} visit written on them.

YELLOW BRACELET – FOR 1^{st} vaccine visit

At BCG	• I give you the YELLOW bracelet because you came for 1^{st} vaccine visit. • When you come TIMELY onto the 4^{th} vaccine visit I will exchange the bracelet to a GREEN bracelet.
At Penta1, Penta2	• I give you the YELLOW bracelet **not** because of this visit but because you came for 1^{st} vaccine visit. • When you come TIMELY onto the 4^{th} vaccine visit I will exchange the bracelet to a GREEN bracelet.

GREEN BRACELET – For TIMELY 4^{th} vaccine visit, at 14 weeks (~3.5 months)

At Penta3	• I give you the GREEN because you came ON TIME for the 4^{th} vaccine visit. • When you come for the 5^{th} vaccine visit I will exchange the bracelet to a NEW one of the same color.
At Measles I or II	• I give you the GREEN **not** because of this visit but because you came ON TIME for the 4^{th} vaccine visit. • When you come for the 5^{th} vaccine visit I will exchange the bracelet to a NEW GREEN bracelet.
Defaulter Message	
At Penta3, Measles I or II	• You don't get GREEN bracelet because you did **not** come ON TIME for 4^{th} vaccine visit. I give you a NEW YELLOW. • When you come for the 5^{th} vaccine visit I will exchange the bracelet to a NEW YELLOW bracelet.

SICI Project 2016

Figure F2: Clinic Staff Messaging Cards, Signal at 4

Social Incentives for Child Immunization

Messaging card

Please give the following messages to caregivers.

Show the bracelets to the caregivers and say – we give the YELLOW bracelet for the 1^{st} vaccine visit; we give the GREEN bracelet to a child that comes TIMELY for 5^{th} vaccine visit. The bracelets have 1^{st} and 5^{th} visit written on them.

YELLOW BRACELET – FOR 1^{st} vaccine visit

At BCG	• I give you the YELLOW because you came for 1^{st} vaccine visit. • When you come TIMELY onto the 5^{th} vaccine visit I will exchange the bracelet to a GREEN bracelet.
At Penta1, Penta2, Penta3	• I give you the YELLOW bracelet **not** because of this visit but because you came for 1^{st} vaccine visit. • When you come TIMELY onto the 5^{th} vaccine visit I will exchange the bracelet to a GREEN bracelet.

GREEN BRACELET – For TIMELY 5^{th} vaccine visit, at 9 months

At Measles I	• I give you the GREEN because you came ON TIME for the 5^{th} vaccine visit.
At Measles II	• I give you the GREEN **not** because of this visit but because you came ON TIME for the 5^{th} vaccine visit.
Defaulter Message	
At Measles I or II	• You don't get GREEN bracelet because you did **not** come ON TIME for 5^{th} vaccine visit. I give you a NEW YELLOW bracelet.

SICI Project 2016

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Figure F3: Clinic Staff Messaging Cards, Signal at 5

Notes: In all bracelet treatments, clinic staff were told to continue reminding parents of their children's due dates as they would normally do (e.g. to come for vaccine five at 9 months of age, as indicated on the messaging cards). In Signal at 4 and Signal at 5, nurses were told to allow for a small delay in vaccination when giving out the green bracelet, as per the design's timeliness cut-offs (Figure I).

Social Incentives for Child Immunization

General rules for bracelet distribution

Actions to be taken by the clinic staff, please.

<u>If the baby loses the bracelet:</u>

- Register the baby in the Pikin Register, as you would normally do. And indicate bracelet loss with "L" in column of bracelet color.
- Do NOT replace the bracelet!
- Tell mother to bring the lost bracelet to the clinic if she finds it and say that you will exchange it for new one then.

<u>If the baby left the bracelet at home:</u>

- Do NOT give the baby a new bracelet!
- If the baby is due for a bracelet exchange, tell mother that bracelet will be exchanged when she comes back with the old bracelet.

<u>If baby's parent does not want baby to wear the bracelet:</u>

- Register the baby in the Pikin Register, as you would normally do. And indicate bracelet refusal with "R" in column of bracelet color.
- Explain to caregiver that bracelet is meant to help remind her/him to take the child for immunizations.

<u>If baby comes with bracelet from other baby:</u>

- Verify that the bracelet is not the baby's bracelet but belongs to another child.
- Take the bracelet from the child and keep it in the bracelet return back. Give the child its own correct bracelet.

<u>If baby's parent prefers the other color:</u>

- Tell the parent you give out the bracelet according to set RULES. Go to messaging card and read out the message.

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Figure F4: General Rules for Handout of Uninformative, Signal at 4 and Signal at 5 Bracelets

Sensitization on Child Immunization

ARM 1

Sensitization on Child Immunization

- New programme for pikin immunization implemented by the Ministry of Health and Sanitation through the Child Health/EPI Programme and District Health Management Team (DHMT). Innovations for Poverty Action (IPA) supports MoHS and DHMT with the implementation and research on program.
- IPA is a research organization based in Freetown. IPA has done extensive work alongside Government Ministries in Health, Agriculture and Education.

Facilitator Please Note

- That you must have your sensitization assessment community form open and fill it alongside
- Encourage participation by all
- Moderate the training very well and focus more on the key areas

The Key Idea

- The MoHS and clinic staff in partnership with IPA, have agreed to engage in community awareness raising and sensitization on immunization as a way to encourage caregivers to take their children for timely and complete immunization.

Importance of Immunization

- Some people may not exactly know how valuable immunizations are for a child and the community's health and well-being.
- Immunizations can prevent your child from diseases.
- It will make your child grow healthy.
- It reduces household spending on seeking health care services when the child falls ill.
- It reduces the spread of diseases among children and other community members.
- Every caregiver should take their child for 6 immunization visits between 0 to 15 months old. Plus another 2 visits for Vitamin A and deworming pills.

Immunization Schedule

- **Facilitator:** explain the immunization schedule to the participants. **Showing the growth card** and when immunizations are at the clinic.

Figure F5: Script for Information Meetings in Control Group Communities

What are the barriers to Immunization

Facilitator: Ask them to come up with reasons why people don't bring their children for immunization. You can add the following if not mentioned by a participant:

1) Ignorance about the importance of immunization
2) Forgetfulness about the dates to come for vaccine
3) Little interest in child issues
4) Transport cost for long distances

7

What are the barriers to Immunization

- 5) Laziness
- 6) Too busy with other work
- 7) Supply related issues, vaccine not in stock, nurse not around
- 8) Afraid of needles or perceived side effect
- 9) Cultural beliefs about vaccinations

8

Addressing the barriers to immunizations

- **Facilitator** ask: Do caregivers in your communities face some or all of the challenges outlined? Have them discuss these points and state which are relevant in their own communities.
- If yes: How can we address them in a non-punitive way?

- **Facilitator:** Allow them to come up with suggestions.

9

Recap on Presentation

- Now we want to go over what we discussed so far.
- Recap on the importance of immunizations.
- Recap on the challenges on immunizations and its solution.
- Recap on the number of vaccine visits and schedule.

10

Dissemination Strategy

- Now we are about to talk on how to take the awareness raising and sensitization information to other members of our community so everyone will learn and know about the immunizations.

Facilitator: Ask participants on what ways they may want to pass the sensitization message to others?

11

Concluding Statements

- Clinic in-charge or any staff (if Central VDC meeting)
- Rep from community (if Community meeting)
- Village chief
- Facilitator

12

Social incentives for Child Immunization

ARM 4

Social incentives for Child Immunization

- New programme for pikin immunization implemented by the Ministry of Health and Sanitation through the Child Health/EPI Programme and District Health Management Team (DHMT). Innovations for Poverty Action (IPA) supports MoHS with the implementation and research on program.
- IPA is a research organization based in Freetown. IPA has done extensive work alongside Government Ministries in Health, Agriculture and Education.

Facilitator Please Note

- That you must have your sensitization assessment community form open and fill it alongside
- Encourage participation by all
- Moderate the training very well and focus more on the key areas

Immunization Schedule

- **Facilitator:** explain the immunization schedule to the participants. **Showing the growth card** and when immunizations are at the clinic.

Bracelets as Social Incentives

- The MoHS, DHMT and clinic staff in partnership with IPA, have agreed to introduce colorful bracelets as an encouragement for caregivers to take their children for timely and complete immunization.
- Bracelets will be given as token of recognition for certain vaccine visits to show that child has progressed well in the schedule.

How are the bracelets given out?

Clinic staff have full instructions on how to give the bracelets to the children.

- A yellow bracelet is given for the 1st immunization visit a child makes. The yellow bracelet shows the child has successfully begun immunizations.
- A yellow bracelet is given for the 1st immunization visit a child has made.
- A green bracelet is given for a TIMELY 5th immunization visit a child makes. The green bracelet shows that the child has progressed well in the schedule.
- A green bracelet is given for a TIMELY 5th immunization visit a child has made.

Figure F6: Script for Information Meetings in Bracelet Communities

How is the bracelet exchanged?

- The yellow bracelet will be exchanged to a new yellow bracelet, when the child comes for 4th visit.
- The yellow bracelet will be exchanged to a green bracelet when the child comes TIMELY for the **5th visit** and brings the yellow bracelet.
- The yellow bracelet will NOT be exchanged for a green bracelet if the child comes late for the 5th visit. Instead, the child will receive a new yellow bracelet.
- Every child who comes for immunization to the clinic will receive a bracelet.

7

What do the bracelets mean?

- When you see a child with yellow bracelet, it means the child has gone for at least 1st visit for immunization. The child has begun immunizations.
- When you see a child with green bracelet, it means the child went on time for timely 5th visit for immunization. You will not be able to tell whether the child has come for 6th immunization visit.
- It is the caregiver's and everyone's responsibility to ensure their children are immunized.
- ANY Questions!

8

The Bracelet Song

- The bracelets come with a song to remind caregivers and everyone on what the bracelets are for and how they are given.

9

Role Play

- Now we are going to have a drama that will further explain what the bracelet stands for and how it should be given.
- Facilitator and Female Member role play.
- Facility and a Male role play.
- Ask participants what they learned from the role play.

10

Dissemination Strategy

- Now we are about to talk on how to take the bracelet information to other members of our community so everyone will learn and know about the bracelet.
- **Facilitator:** Ask participants on what ways they may want to pass the sensitization message to others?

11

Importance of Immunization

- Some people may not exactly know how valuable immunizations are for a child and the community's health and well-being.
- Immunizations can prevent your child from diseases.
- It will make your child grow healthy.
- It reduces household spending on seeking health care services when the child falls ill.
- It reduces the spread of diseases among children and other community members.
- Every caregiver should take their child for 6 immunization visits between 0 to 15 months old. Plus another 2 visits for Vitamin A and deworming pills.

12

What are the barriers to Immunization

Facilitator: Ask them to come up with reasons why people don't bring their children for immunization. You can add the following if not mentioned by a participant:

1) Ignorance about the importance of immunization
2) Forgetfulness about the dates to come for vaccine
3) Little interest in child issues
4) Transport cost for long distances

13

What are the barriers to Immunization

- 5) Laziness
- 6) Too busy with other work
- 7) Supply related issues, vaccine not in stock, nurse not around
- 8) Afraid of needles or perceived side effect
- 9) Cultural beliefs about vaccinations

14

Addressing the barriers to immunizations

- Facilitator Ask: Do caregivers in your communities face with some or all of the challenges outlined?
- If yes: How can we address them in a non-punitive way?

- Facilitator: Allow them to come with suggestions.

15

Concluding Statements

- Clinic in-charge or any staff (if Central VDC meeting)
- Rep from community (if Community meeting)
- Village chief
- Facilitator

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