Barriers to and Incentives for Health Behaviors among African Women

by

Ryoko Sato

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Economics)
in the University of Michigan
2015

Doctoral Committee:

Professor David A. Lam, Co-Chair
Assistant Professor Rebecca Lynn Thornton, Co-Chair
Assistant Professor Raj Arunachalam
Professor Edward C. Norton

Acknowledgments

I am very grateful to my advisors, Rebecca Thornton, David Lam, Raj Arunachalam, and Edward Norton. Their continuous support has guided me and encouraged me. I could not have reached where I am without them.

This thesis has benefited from discussions with the faculty and students at University of Michigan and other institutions. My appreciation goes to Hitoshi Shigeoka for his advice and his care. I thank Hoyt Bleakley for providing very valuable insight. I would like to thank Jing Cai for her valuable comments and support. My sincere gratitude goes to the survey team in Nigeria. I appreciate Abdullahi Belel for his support to make this project happen in Adamawa State, Nigeria. I am grateful to Benjamin Fintan for his diligence, honesty, and friendship at the field.

I have been fortunate to receive generous financial support from University of Michigan, Institute for Research on Women and Gender, Rackham Graduate School, Department of Afroamerican and African Studies, Department of Economics, Center for the Education of Women, and from Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research and Yamada Scholarship Foundation.

I would like to thank Ibrahima Ndiaye for his love, encouragement, and belief in me. His existence made my life at graduate school brighter. I would like to thank my parents for making this journey possible.

I dedicate this dissertation to women and children in Nigeria whom I met

and I did not meet. They are the source of my passion and inspiration to keep going with my research on improving health.

Contents

List of Tables

List of Figures

Abstract

This dissertation looks at health behaviors of African women and the way those behaviors are affected by information, incentives, peers, and own past experiences. I focus on health service utilization by African women such as vaccination and institutional delivery because the health facility utilization remains severely limited in most parts of sub-Saharan Africa, despite its high effectiveness on health outcomes. The dissertation uses data that I collected myself in Nigeria as well as Demographic and Health Survey data for 26 African countries to evaluate barriers to and incentives for health behaviors among African women.

This first chapter causally evaluates the relative importance of psychic costs as channels for low vaccination take-up compared to other barriers: monetary costs and priming about disease severity. I measure each channel by evaluating a field experiment among women which randomizes several factors that affect tetanus vaccine take-up in rural Nigeria. This is the first study to report the experimental evidence on psychic costs of vaccination. Although conventional wisdom drawn from observational studies highlights the relevance of psychic costs, I found no evidence that psychic costs limit vaccination take-up. 95.7 percent of women who were incentivized just to show up at a clinic, unconditional on vaccine take-up, chose to receive the vaccine anyway. Priming about disease severity using salient images of tetanus patients increased perceived costs of disease but did not affect vaccination

take-up. Rather than these psychic costs being important barriers, direct cash incentives had the largest effects on vaccination take-up. Small cash incentives increased vaccination take-up by almost 20 percentage points from 55 percent. The results in this paper confirm economic barriers to take-up and find no evidence that psychic costs play a significant role, at least among more than 85 percent of respondents who responded to cash incentives.

The second chapter examined the effect of the death of an infant on their mothers' health behaviors for their subsequent children, using Demographic and Health Surveys (DHS) from 26 African countries. Child's death induces mother's behavioral changes. I found that mothers who experienced the death of their first child were 1.5 percentage points more likely to deliver their second child with some assistance and 2.5 percentage points more likely to deliver their second child at health facilities than mothers who did not experience the first child's death.

The third chapter analyzes the effect of social networks on vaccination behaviors among women in rural Nigeria, using the same experimental data that I used in Chapter 1. Social networks within village, neighborhoods, and among friends all influence one's vaccination decision to a great extent. I find that the effect of one additional friend getting vaccinated increases the likelihood of one's receiving a vaccination by 17.2 percentage points. Focusing on best friends, I additionally find that the effect of a best friend receiving a vaccine on one's vaccination decision varies by the distance to a health clinic, by the distance between a woman and her best friend, and by the belief about vaccine safety.

Chapter 1

Psychic vs. Economic Barriers to Vaccine Take-up: Evidence from a Field Experiment in Nigeria

1.1 Introduction

Every year vaccinations avert over a million deaths from tuberculosis, over half a million from polio, and 800,000 from tetanus (Ehreth, 2003). Vaccination is an extremely cost-effective strategy to improve individual health worldwide. For example, treating one case of measles costs 23 times the price of one vaccination and $24 are saved for every $1 spent on the diphtheria-tetanus-pertussis (DTP) vaccine (Ehreth, 2003). Despite these benefits, there still are an estimated 22.6 million infants annually who are not sufficiently vaccinated worldwide, primarily in developing countries (WHO, 2014). Given the large financial and health benefits of preventing disease, the relatively low take-up rates remain a puzzle. This paper reports the results of a field experiment designed to evaluate various potential barriers to vaccination in Nigeria, which is home to 12.4 % of the world's unvaccinated infants.

Past studies have suggested various reasons for low vaccination take-up based upon survey responses. They include monetary costs to attend health clinics such as transportation costs and opportunity costs (Thysen et al, 2014; Uzochukwu et al., 2004), limited information about diseases and vaccinations (Orimadegun et al., 2014) and supply-side constraints such as vaccine shortages (Santibanez et al., 2012). Furthermore, psychic costs, which are residuals that cannot be explained by monetary reasons such as beliefs and attitudes about vaccines, could be influential on vaccination decisions (Pebley et al., 1996; Steele et al., 1996).[1] Most past studies examined barriers to vaccine take-up in qualitative ways, for example by asking subjects their reasons for non-vaccination (DHS 2008; Jheeta and Newell, 2008; Nichter, 1995; UNICEF, 2001). However, such qualitative studies cannot identify the causal effect of each barrier on vaccination behavior.[2] This paper causally examines and compares the behavioral effect of monetary costs, psychic costs, and perceived disease severity on vaccine take-up.

The examination of psychic costs, such as fear of needles or of side effects, is of particular interest. The relevance of psychic costs as barriers to vaccination has been widely documented in Africa. In northern Nigeria, a polio vaccination campaign was famously boycotted by Islamic leaders due to false rumors that polio vaccines make women infertile or contract HIV (Jegede,

[1]Examples of beliefs and attitudes about vaccines as psychic costs of vaccination include fear of needles, fear of the vaccine safety such as side effects, misperception about vaccines such as the belief that vaccines might give HIV or other diseases, and religious belief against vaccines.

[2]Currie (2006) reviewed literature which examined the effect of stigma on the take-ups of social benefits in developed countries. Stigma she used here is disutility arising from participating awelfare program per se (Moffitt, 1983). She drew a general conclusion that stigma is not a large barrier to participating in social benefits program. However, the studies she cites provide suggestive evidence of small effects of stigma on benefit uptake, and do not provide causal evidence.

2007). This distrust against vaccine efficacy spread widely among the general population, which led to the refusal of polio vaccinations by many people. A similar incident opposed a tetanus vaccination campaign in Cameroon in 1990 (Feldman-Savlesberg, 2008), as well as polio vaccination campaigns in Kenya, Uganda, and Tanzania (UNICEF, 1997). These documents lead to a common presumption by researchers that psychic costs of vaccination are large barriers to vaccination. However, there has not been a causal study to confirm these observations.

In order to causally measure the effect of each channel on vaccination take-up, I implemented a field experiment in rural Nigeria that randomized several factors focusing on tetanus vaccination among women. To address the effect of monetary costs on vaccination, I randomized the size of conditional cash transfers (CCT) provided to women conditional on their clinic attendance. To study the effect of psychic costs on vaccination decisions, one group of women had their CCT further conditioned on receiving the vaccine. Because the only difference between these conditions was whether one was required to receive a vaccine for cash incentives, the difference in clinic attendance under these two conditions showed the effect of the psychic cost of being vaccinated on the vaccination decision. I also randomized the disease message, either a "scared-straight" message that emphasized the severity of tetanus or a control message that provided the same information on tetanus without the emphasis of disease severity, to address the effect of perceived disease severity on vaccination while controlling for the information on disease.

I find that psychic costs of vaccination are not a large barrier to vaccination, contrary to the conventional wisdom from observational studies. The clinic attendance of respondents who were offered cash compensation for clinic visit but not required to receive a vaccination was not different from the clinic attendance of respondents who were required to get a vaccination at a clinic in order to receive cash compensation. Furthermore, an extremely high proportion (95.7 percent) of women received a vaccination after they visited a clinic, even though vaccination was not necessary for cash rewards. This result indicates that psychic costs of vaccination are not significant as barriers to vaccination. My finding contradicts previous observational studies which emphasize psychic costs as major barriers to vaccination (Rainey et al., 2010). My study highlights the need for behavioral experiments, rather than observational studies, to identify the causal relationship between psychic costs and vaccination take-up. However, one limitation of the study is that the result of small psychic costs is not generalizable to 13.3 percent of respondents who refused to attend the clinic even at the highest amount of CCT.

Monetary costs of clinic visits greatly affect the vaccine take-up. Conditional cash incentives (CCT) significantly increase vaccination take-up by compensating for monetary costs of clinic visits, i.e., transportation costs and opportunity costs. Two dollars in cash incentives increased vaccination take-up by 19.4 percentage points from 55.8 percent, while $5 increased the take-up by 27.7 percentage points. $2 is about two-day earnings per person, and a little over the average transportation costs (both way) to clinic among those who needs to pay for transportation. While the larger monetary costs of clinic visit significantly reduce the vaccination take-up, the effect of the cash is stronger among those with larger monetary costs of clinic visits. This result is consistent with the claim that cash incentives relax monetary constraints for clinic visits. I also contribute to literature on the effect of CCTs on behavior because this study is the first to use vaccination as a sole conditionality for a CCT in a developing country (Barham and Maluccio, 2009).[3]

[3]Sutherland et al. (2008) conducted a review on the effect of cash incentives on vaccination rate in developed countries, and conlcuded that cash incentives were effective in promoting the vaccination rate. Weaver (2014) found that cash incentives of 10 euros increased the vaccine take-up by 27 percentage points.

I find that priming about disease severity increases the perceived costs of disease as intended, but it does not increase vaccination take-up. While vaccine take-up was not enhanced by priming, it significantly increased the perceived likelihood that respondents believed people die of tetanus. It also increased the likelihood that respondents felt very worried about contracting tetanus and that respondents thought tetanus was a very bad disease by 14.3 and 13.8 percentage points, respectively. Furthermore, priming increased subjects' heart rate by 6.27 beats per minute, implying that the priming induces the emotional response. While this finding is consistent with some of the recent literature on framing and fear appeals in developed countries (Nyhan et al., 2014),[4] I contribute to the literature because my study uses improved measures such as actual vaccination behavior instead of hypothetical behavior, which has been commonly used in past studies. I measure heart rates in order to objectively understand the emotional response to priming intervention, in addition to commonly-used subjective measures of risk perception.

Although my results suggest that psychic costs of vaccination are not the large barriers, further studies need to evaluate the relevance of such psychic costs among women who did not attend the clinic even if they were offered the high amount of cash incentives.

1.2 Background

This section provides the overview of potential barriers to vaccination. I address monetary costs, psychic costs, and salient information about disease severity which have had support as channels of vaccine take-up in literature. This paper particularly focuses on conditional cash transfer (CCT) as

[4] Consistent with results from my study, Nyhan et al. (2014) found that priming altered perceptions, but not the intended behaviors.

a tool to compensate for monetary costs, and priming intervention as a tool to convey salient information about disease severity. I also introduce the tetanus-toxoid vaccine as a focus of the study.

1.2.1 Overcoming Barriers to Vaccination

This section introduces past studies that evaluated each channel influencing vaccination behavior: conditional cash transfer and priming interventions to increase vaccination take-up, and psychic costs as potential barriers to vaccination. I introduce what past studies have not done to highlight the contribution of my paper.

Conditional Cash Transfer (CCT)

Although conditional cash transfer programs (CCTs) have been successful in promoting health behaviors in developing countries, their effects on vaccination have never been accurately measured. I accurately evaluate the effect of CCT on vaccination take-up by implementing a rigorous experiment. Because one of major barriers to vaccination is monetary costs such as transportation cost and opportunity cost (WHO, 2008; Canavati et al., 2011), one way to compensate for monetary barriers is to directly provide cash incentives.[5] In this section, I introduce the effect of conditional cash transfer programs (CCTs) on vaccination.

Despite the success of CCTs in promoting health service utilization (Lagarde 2009), there has not been a CCT program that exclusively focuses on vaccination take-up as a sole conditionality for receiving an incentive

[5] In addition to providing cash incentives to the demand side, we can also incentivize the supply-side, for example, by providing financial incentives to maintain a certain standard of service quality such as performance-based financing (PBF) (Meessen et al 2011). In my study, I do not directly measure the effect of vaccine supply. Rather, I eliminate the concerns of vaccine supply by informing respondents that there is sufficient vaccine available for the project.

(Barham and Maluccio, 2009). Rather, existing CCTs included vaccination as one of the conditionalities along with other behaviors, such as regular health check-ups and school attendance (Gertler 2004, Barham and Maluccio 2009, Robertson et al. 2013). Thus, it has been difficult to identify how cost-effective the CCT program is on vaccination take-up, as only the combined effects of various conditionalities of CCTs have been measured.

Furthermore, it is found that effects of such CCTs with multiple conditionalities on vaccination have been small and limited in developing countries (Morris et al., 2004; Robertson et al., 2013; Barham and Maluccio, 2009; Salinas-Rodríguez and Manrique-Espinoza, 2013). Past studies might have failed to find a large effect of CCTs on vaccination because multiple conditionalities made it difficult to measure the accurate effect of CCT. Thus, my study examines the effect of CCT with a sole conditionality to increase the accuracy of measuring the effect of CCT on vaccination. One exception is a study from Banerjee et al. (2010) which sets the children's vaccination as a sole conditionality and finds a large incentive effect. They found a large effect (20 percentage-points increase) of a small in-kind transfer (equivalent to $2.85) on the vaccination rate among children. However, their study boosted vaccination take-up through supply-side intervention as well; they set an immunization camp in each village. My study examines the effect of CCT with one conditionality without controlling for supply side.

Psychic Costs of Vaccination

It is conventional wisdom that psychic costs, residuals that cannot be explained with monetary costs for vaccination take-up such as the fear of needles or the concern for the vaccine safety, are the large barrier that obstructs people from vaccination. But the effects of psychic costs on vaccination have not been causally tested. Thus I causally examine the behavioral effect of psychic costs on vaccination.

To highlight observational evidence on psychic costs of vaccination, I provide two sets of qualitative evidence. First, Nigeria Demographic and Health Survey (NDHS, 2008) revealed that more than one third of women who did not take their children for vaccination indicated their reasons of non-vaccination as psychic costs of vaccination (36.8 percent). They indicated reasons of non-vaccination as fear of side effects, fear that their children may get diseases from the vaccine, and because they thought that vaccines did not work. Other reasons include a lack of information (27.2 percent) and distance to a health clinic (13.4 percent). Psychic costs of receiving a vaccine are mentioned by people as one of the major reasons of non-vaccination, and this trend is not limited to Nigerian context. Rainey et al. (2010) conducted a systematic review and also identified that psychic costs accounted for 17.2 percent of reasons of non-vaccination in 51 low and middle income countries.

Secondly, the Nigerian vaccination boycott campaign also demonstrates the high psychic costs in the form of distrust against vaccines. It was observed that three northern Nigerian states boycotted the polio immunization campaign in 2003 due to a suspicion of the vaccine safety. Islamic leaders propagated the suspicion to the public that polio vaccines could make women infertile or contract HIV (Jegede 2007) which resulted in the refusal of polio vaccine take-up by population. The boycott caused the decreased acceptance of polio vaccine in northern Nigeria, the increased polio-virus transmission throughout the country (Centers for Disease Control and Prevention, 2005), and the spread of polio into twenty countries (Kaufmann and Feldbaum 2009). Similar refusal of vaccination campaign for polio and tetanus due to distrust has been observed across Africa.

Priming about Disease Severity

Although the effectiveness of priming has been examined in previous studies, results have been inconclusive. Using improved measures, I evaluate the effect of priming intervention, which emphasizes the disease severity, on vaccination take-up.

The potential effect of priming about disease severity can be considered in the context of behavior change communication. This is based on the utility maximization; information about the true effect of a health input increases allocative efficiency by changing the perceived benefit (Grossman, 2000). It implies that if one invests in vaccination at a level that is less than optimal, then providing accurate information should increase the perceived benefit of vaccination and increase the demand for vaccination. In other words, emphasizing the negative side of non-vaccination has a potential to induce vaccination take-up by making the vaccine comparatively beneficial by increasing the perceived costs of disease.

Findings on the effectiveness of priming, however, are inconclusive. Framing theory suggests that priming is less effective in promoting vaccination than emphasizing the positive consequences of utilizing health services, postulating from prospect theory which states that the disutility from losses is much more than the utility gain from the same amount of benefits (Kahneman and Tversky, 1979; Rothman and Salovey, 1997).[6] [7] On the other hand, there are experimental studies that found priming the negative consequence of non-vaccination was more persuasive for promoting vaccination than priming the positive side of vaccination (Abhyankar et al., 2008; Gerend and Sheperd, 2007), while some others found no comparative advantage of

[6]A method that emphasizes the salience of disease severity to promote vaccination behavior can also fit into the idea of fear appeals, which intends to promote a particular behavior by arousing fear (Witte and Allen, 2000). Similar to findings on the effectiveness of framing, however, results on persuasiveness of fear appeals have not been consistent (Dillard and Anderson 2004, Job 1988, Jepson and Chaiken 1990).

[7]Priming the negative consequence of vaccination can be less effective under the assumption that vaccination behavior involves no risk. This is because prospect theory says that people prefer taking risks when considering loss but avoid risk when considering gains (Rothman et al., 1993). However, it is actually possible that people find vaccination risky, if perceived vaccine safety and vaccine efficacy are the problem.

the priming (O'Keefe and Nan, 2012; Nyhan et al., 2014). Thus I use improved measures of actual vaccination take-up to causally study the effect of priming of disease severity on vaccination.

Literature suggests that the priming about disease might affect the decision process, not only the overall decision to vaccinate, although the direction of the effect is ambiguous. If the increased perception of disease severity makes one feel the need to eliminate the risk of contracting the disease, it might hasten one's vaccination timing. On the other hand, fear appeals literature indicates that a fearful event has an adverse effect on information processing that can lead to a delay in vaccination take-up (Jepson and Chaiken 1990). We can think of the relationship between the fear and the decision to vaccinate over time in the framework of anticipated dread; people might behave according to the fear that they expect to perceive in the future. Harris (2010) documented that people often choose to undergo unpleasant events sooner rather than later, but the result can be reversed if such a fearful event does not involve a monetary compensation (Myerson and Green 1995, Rachlin et al., 1991). Thus, priming intervention might have delayed the vaccine take-up without cash incentives, while it might have hastened their vaccination decision once they were offered a higher amount of CCT.

1.2.2 Tetanus-toxoid Vaccine

I study tetanus-toxoid vaccines which are life-saving and free, but do not have a high take-up rate. Nigeria is one of twenty five countries where tetanus still is a major public health problem (WHO, 2013). Tetanus attributes to high neonatal mortality rate, up to 20 percent in Nigeria (Oruamabo, 2007). However, the take-up of tetanus vaccines remains low; 52.8 percent (DHS, 2013). Thus, this study focuses on tetanus-toxoid vaccine to evaluate how to improve tetanus vaccination take-up.

Fatality of neonatal tetanus reaches almost 100 percent without medical treatment which is difficult to obtain in rural Africa (Blencowe et al, 2010). In addition to high mortality, the typical symptom of tetanus is severe as tetanus is extremely painful. Symptoms commonly include a series of muscle spasms which accompanies severe pains.[8] [9]

Tetanus-toxoid vaccine is the most effective way to prevent neonatal tetanus. Because neonatal tetanus is typically contracted at the time of delivery when the umbilical cord is cut with a non-sterile instrument, hygienic delivery also prevents tetanus incidence, in addition to the tetanus-toxoid vaccine. However, providing tetanus-toxoid vaccines to mothers most efficiently protects both mothers and newborn babies from tetanus. Providing the tetanus-toxoid vaccination to mothers prevents neonatal tetanus with efficacy of over 80 percent with 5 years of protection if one follows the correct vaccination schedule.

Although the actual benefit of the vaccination is high, the vaccination take-up is low in Nigeria as compared to other countries. While the proportion of newborn babies worldwide who were protected from the neonatal tetanus is 82 percent (WHO, 2011), only 52.8 percent of the births were fully protected from neonatal tetanus through tetanus toxoid vaccination to mothers in Nigeria (DHS, 2013). In order to improve maternal and newborn

[8] Although tetanus toxoid vaccination can be accompanied with side effects like any other vaccinations, symptoms are not severe in almost all cases (Middaugh, 1979). Common adverse responses to the tetanus toxoid vaccination include sore arm, swelling, and itching which are considered mild.

[9] Following instructions for the vaccination to have a high impact is important. According to WHO, women at childbearing age and pregnant women are recommended to receive multiple doses of tetanus toxoid vaccine. Receiving multiple doses prevents neonatal tetanus while take-up of the single dose is not sufficient to prevent neonatal tetanus deaths; it can only prevent 43 percent of neonatal tetanus deaths (Ogunlesi, 2011). It is also important to follow the vaccination schedule for the vaccination to be effective. First dose should be taken at first contact or as soon as possible in pregnancy followed by second dose at least four weeks after the first dose and third dose six months after the second dose (WHO, 2006). My study, however, exclusively focuses on the single-dose take-up of tetanus vaccination.

babies' health, the local government of Adamawa state in Nigeria, where I conducted the study, has been providing free antenatal care service including the tetanus toxoid vaccination to pregnant women. Despite this government effort, the vaccination rate in the study area remains low: only 66.5 percent of pregnant women were sufficiently vaccinated against tetanus. (DHS, 2013).

1.3 Experiment Design

In order to study the effect of various potential barriers on vaccination take-up, I implemented a field experiment which randomized several factors. Particularly, I randomized three different factors; the amount of cash incentives, the condition for cash incentives, and the type of disease message.

1.3.1 Conditional Cash Transfer (CCT)

In order to measure the effect of monetary costs on vaccination, I randomly varied the amount of conditional cash transfer (CCT) offered to each respondent. The amount of money offered was randomly assigned to each respondent: either 5 naira (approximately 3.3 US. cents), 300 naira (2 US. dollars) or 800 naira (5.3 US. dollars). As a reference, the average daily earnings per household was approximately 1,000 naira and that per person was 144 naira in my study. The average transportation cost to the health clinic was about 250 naira both way among those who needs to pay for the transportation while 50 percent of the sample did not pay for the transportation. Interviewers randomly picked a questionnaire out of sets of questionnaires they brought when they started a survey with each respondent. Each questionnaire has a page in the middle that indicates the amount of cash incentives that the respondent are assigned to. I design the study so that each village has approximately the equal proportion of respondents who were offered each amount of CCT.

1.3.2 Psychic Costs of Vaccination

In order to identify the psychic costs of vaccination, I randomly varied the condition of CCT under which each respondent could receive the cash compensation. The conditionality was either clinic attendance (Clinic CCT) or clinic attendance and vaccination (Vaccine CCT). Respondents under Clinic CCT could receive some amount of CCT if they visited an assigned clinic regardless of the vaccination take-up, while respondents under Vaccine CCT were entitled to some amount of money if they visited an assigned clinic and received a tetanus toxoid vaccination at the clinic.

The difference in clinic attendance between respondents under Clinic CCT and under Vaccine CCT reveals the influence of the psychic costs on vaccination. This is because additional action is required under Vaccine CCT, vaccination take-up upon clinic visit, in order to obtain the same amount of cash compensation as Clinic CCT. The clinic visit by a respondent under Clinic CCT indicates that she overcomes the monetary cost of clinic visit such as transportation costs and opportunity cost at a certain amount of cash incentive. On the other hand, the clinic visit by a respondent under Vaccine CCT shows that the respondent overcomes the monetary costs of clinic visit as well as the psychic costs of vaccination with the same amount of money.

Thus if we find that the clinic attendance under Vaccine CCT is lower than the one under Clinic CCT, we can say that the difference results from the existence of net psychic costs. Although the Clinic CCT does not require respondents to receive vaccination, they have an option to receive the tetanus vaccination if they wish to. However, this option would not affect the validation of the measurement of the psychic cost of vaccination.

1.3.3 Priming about Disease Severity

To measure the effect of the salient information about disease severity on vaccination take-up, I randomly varied the type of message about the severity of tetanus: either the "scared straight"[10] or the control message. The message was conveyed to each respondent through a flipchart. I prepared two different flipcharts: one with fearful pictures of tetanus patients ("scared straight" flipchart) and another without such graphical information (control flipchart). The "scared straight" flipchart had 15 slides and 7 slides out of 15 showed pictures of various tetanus patients to repeatedly emphasize the severity of tetanus symptoms. The remaining 8 slides demonstrated symptoms of tetanus, severe pains and muscle spasms, with the written Hausa language and introduced the effectiveness of the tetanus-toxoid vaccination. The control flipchart had 8 slides with identical information as the "scared straight" flipchart except that it does not have any pictures of tetanus patients.

The difference in the two types of flipcharts was to capture the effect of priming about disease severity on vaccination behavior. In order to differentiate only the salience of the message but not the information itself by the flipchart, both flipcharts contained the identical verbal information on tetanus and its vaccination. To capture the effect of priming, respondents under the Vaccine CCT were shown the control flipchart to be compared with another group of respondents who were offered cash incentives with vaccination condition with the "scared straight" flipchart (Vaccine CCT &

[10] "Scared straight" originally refers to a program that intends to deter juveniles from future crimes by showing them the life in prison (Petrosino et al., 2004). This is to emphasize the severity of punishment, or the consequence of bad behaviors. I call a message which emphasizes the disease severity as "scared straight" message because the purpose of this message is to emphasize the consequence of non-vaccination, "bad behavior".

Fear).

For the comparison between Clinic CCT and Vaccine CCT to be valid to capture the psychic costs of vaccination, all respondents under both Clinic CCT and Vaccine CCT received the control message. In order to measure the effect of priming, I changed the type of the message only among respondents who were offered the cash under vaccination condition (Vaccine CCT and Vaccine CCT & Fear). Overall across villages, the study has an equally-distributed sample size for each intervention; one third of the total respondents received the Clinic CCT, one third received the Vaccine CCT, and the last third received the Vaccine CCT & Fear.[11]

1.3.4 Intervention Process

In this section, I describe the experiment process. After the baseline interview at each respondent's house, the respondent was shown either the "scared straight" or the control flipchart to inform about tetanus and tetanus-toxoid vaccination. The intervention took place in a closed environment where there was only an interviewer and a respondent at the moment of the intervention in order to avoid an information spillover which is independent of respondents' will.

At the end of the flipchart session, each respondent was told about the cash compensation she could obtain and the criteria under which the respondent was eligible to receive the compensation: clinic attendance or vaccination at the clinic. All the respondents were instructed to go to their assigned health clinics within one week from the baseline interview with the voucher (more detail discussed below) in order to be eligible CCT recipients. Respondents were told that the health clinic were open from Monday to Saturday 8

[11] However, the distribution of sample under each intervention: Clinic CCT, Vaccine CCT, and Vaccine CCT & Fear was different by village to measure the potential effect of social network. But I do not discuss about this in this paper.

am to 5 pm.

Finally, although uncertainty of vaccine supply is considered to be one of the major barriers of vaccination, this study eliminates such a concern because it ensured the sufficient vaccine supply by informing each respondent that she was insured to receive the vaccination if she wished to.

1.4 Data

There are three pieces of data that I used to evaluate the experiment: baseline data, post-intervention data, and data at health clinics. While the baseline and post-intervention interviews took place at each respondent's house, health clinic interviews were carried out at health clinics only among respondents who attended these clinics.

1.4.1 Setting

I conducted the study in Jada local government area, which exhibited the lowest tetanus toxoid vaccination rate in Adamawa state, one of northeastern state. Only 16.3 percent of women received tetanus toxoid vaccination during their pregnancy and almost none of them received the vaccine before their pregnancy in Jada local government (DHS, 2008).

This project was conducted in March of 2013 through May of 2013. It involved 2,530 women from 80 villages. The sample was drawn from three-stage sampling. First, 10 health clinics were selected in a way that they were geographically spread across Jada local government. There was a total of 11 wards (9 rural wards and 2 urban wards) spanning all the villages in Jada and the study exclusively focused on 9 rural wards with each ward having 1 to 5 public health clinics. I selected the main health clinic from each ward with the exception of one large ward under which I selected 2 clinics, which made the total of 10 clinics for my study.

Second, I selected a total of 80 villages which fell within one of the catchment areas of each clinic. Catchment areas of each health clinic were defined by the primary healthcare development agency which was responsible for national immunization campaigns. All the villages within a catchment area of each health clinic were selected if the village had more than 10 households and the total number of villages in a clinic's catchment did not exceed 15. If it did, the priority was given to villages with the furthest distance to the health clinic.

Third, one eligible woman, who was aged 15 to 35, was selected from each household in each village. The survey team visited households in each village to find out if there were any eligible women. A woman was ineligible if she had received a tetanus vaccination in the 6 months prior to the time of the survey in order to avoid overdose. This is because the second dose of the tetanus vaccine should be given to individuals at least 6 months from the first dose. In case where there was more than one eligible woman in one household, the first priority was given to pregnant women who had not received tetanus-toxoid vaccination in the past 6 months. If there were no eligible pregnant woman in the household, then the second priority was given to women who had never received tetanus vaccination before. If we still did not find any eligible women with a priority, then women who did not receive tetanus vaccine in the past 6 months were invited to participate in the survey. If there were more than one woman who were eligible under the same priority, then we randomly picked one of the eligible women by selecting the first one in alphabetical order of the first name. On average, each health clinic covered 249 respondents from 9.6 villages in my study.[12]

[12]One thing to note here is that I did not conduct a census of each village. Thus, the proportion of eligible women in each village was not designed to be fixed. However, the survey team spent more time in larger villages, thus the eligible women should be positively correlated with the size of village.

1.4.2 Baseline, Intervention, and Post-Intervention

A baseline questionnaire was administered to all respondents to capture the prior knowledge, belief, and attitudes on tetanus and vaccination as well as baseline characteristics including demography, health and economy of respondents and their households. Finally the heart rate of each respondent was measured using a heart rate monitor at the baseline survey. This measure was to capture the emotional state of each respondent at the baseline level.

Immediately after the administration of the baseline questionnaire, the intervention took place if respondents agreed to participate in the intervention. After the flipchart session, respondents were provided a voucher which could be redeemed at the assigned clinic and were asked to bring the voucher with them to the clinic. The voucher indicated respondent's name and her unique ID that was assigned by the project, date of the intervention, name of the health clinic to attend, type of the intervention (Clinic CCT or Vaccine CCT), and the amount of cash compensation to be provided. Any redeemed voucher was matched to baseline data through the information on the voucher. My analysis relies on this administrative data to examine the clinic attendance.

After the intervention, a short questionnaire was administered to all the respondents. It asked about respondents' understanding level about tetanus and its vaccine. If a respondent fully understood the contents explained in flipchart, she would have been able to answer all the questions correctly as all information asked in the questionnaire was provided during the intervention. Respondents were also asked if the intervention caused emotional arouse as well as changes in perceptions and beliefs about tetanus and tetanus toxoid vaccination. Questions in regard to knowledge, perceptions and beliefs in this post-intervention questionnaire were identical to those asked in the baseline survey to make them comparable. Comparable questions were used to capture if the flipchart intervention triggered any changes in understanding, perceptions, and beliefs. The heart rate was measured immediately after the intervention once again in the same way as in the baseline survey to measure the emotional response to the flipchart.

1.4.3 Health Clinic

Health clinics were open for the duration of one week after the intervention was carried out to each respondent whose households were within the catchment area of each clinic. Upon attendance at an assigned clinic, all the respondents were asked to form a line to wait to be served no matter which intervention they received. This was to eliminate the difference in waiting times by different treatment namely between Clinic CCT and Vaccine CCT so that the vaccination take-up decision would not be affected by the different waiting time. A brief questionnaire was administered to each attendee when they were served. In the beginning of the questionnaire, the type of the intervention each attendee received was confirmed through the voucher she brought: either Clinic CCT or Vaccine CCT. If the conditionality was "Vaccination", she was provided the vaccination by the health staff right then unless she refused it (although this case did not happen where a woman under Vaccine CCT visited the clinic but refused the vaccination). Then, the interviewer recorded that she received a vaccination in the survey. If the conditionality was "Clinic Visit", then the attendee was asked if she would like to receive the vaccination. If she agreed, then the health staff gave her the vaccination right then. Whereas if refused the vaccination, she simply continued the questionnaire. Then this vaccination decision was recorded in the survey. The process of receiving a vaccination did not waste anytime because the interviewer was filling out the administrative information in the questionnaire such as the date of the interview and copying the unique ID from the voucher to the survey form while the health staff was giving her a vaccination right at the same place.

The questionnaire at health clinic recorded the data and time of the attendee's visit, means of transport from her house to the clinic, transportation costs, and perceptions about tetanus toxoid vaccination. It also asked about other services she came to utilize for, as well as other household members she brought along if there was any. At the end of the interview, monetary compensation was made with the exchange with the voucher.

1.4.4 Descriptive Statistics and Balancing Tests

Here I confirm the internal validity of the research design. I also describe characteristics of respondents and show my sample is not so different from national representative sample.

My analysis is based on 2,482 women aged 15 to 35 years old at the time of baseline survey who did not receive tetanus-toxoid vaccination in the past 6 months. Each of experimental treatment, Clinic CCT, Vaccine CCT, and Vaccine CCT & Fear has a relatively equal proportion of respondents who were offered each amount of CCT (Figure 1.4). Table 1.1 presents the summary statistics of the full sample by experimental treatments. On average respondents are 25 years old and just about half of the sample is Muslim. Almost half of the women, 48.3 percent, did not receive any form of education. Many respondents (43.5 percent) have paid work and the average household earning per capita last month was 5,000 naira (approximately 33.3 US dollars). 15.3 percent has never been married and 76.5 percent had at least one child. Around 18 percent of respondents were pregnant at the time of baseline survey. Majority of respondents, 72.2 percent, have previously visited the health clinic which was assigned to each respondent under this study and the distance to the clinic was on average 1.7 kilometers. Overall, 39.8 percent of women have ever received tetanus-toxoid vaccination at least once. Around 18 percent of respondents believe that vaccines give HIV, while more than 90 percent think that vaccines protect one from diseases. More than 60 percent of respondents feel that needles of injections are scary and vaccines have side effect. Around 25 percent of women think vaccines give diseases.

Demographic characteristics are comparable to those of the representative sample collected through Nigeria Demographic and Health Survey (DHS, 2008). While Nigeria DHS sampled women aged 15 to 49, I restrict the DHS sample to women aged 15 to 35 to compare with the data from my study as the eligibility for my study is women aged 15 to 35. In the DHS sample, over half of the women were Muslim (57.3 percent), about half of the sample (49.6 percent) has never received any education and 62 percent of women have a work at the time of baseline survey. These characteristics are very similar to ones in my study. Only a small proportion of women in DHS sample were single (2 percent) and majority (96.3 percent) has at least one child. Fourteen percent was pregnant at the time of DHS survey and 31.8 percent has ever received the tetanus vaccination before. Overall, descriptive statistics of most variables from DHS survey are statistically not different from those from my study (Table not shown).

Randomization check in Table 1.1 (column 4 and 8) find very few difference between treatment groups. For all the demographic variables listed above, I could not reject the equality of means between each treatment except age. Age, on other hand, was found to be higher among respondents who were offered the highest amount of cash incentives. I found some differences in variables that captures concerns about vaccines, such as that needles are scary and that vaccines have side effects, I control for these variables in all my specifications.

1.5 Three Barriers to Vaccine Take-up

This section reports results about the effect of monetary costs, psychic costs, and salient information about disease severity on vaccination take-up respectively. Surprisingly, psychic costs are not the large barrier to vaccination, contrary to a common belief. Priming about disease severity did not alternate vaccination behavior, while it increased perceived severity of disease. On the other hand, I found that cash incentives promoted vaccination to a great extent.

Overall clinic attendance and vaccination take-up was very high. Figure 1.1 presents that 73.7 percent of women visited a clinic, while 72.6 percent received the vaccination. This is very high as compared to baseline vaccination take-up, which was 39.8 percent. This high vaccination take-up might be due to the information on tetanus and vaccination, which was provided in some form to all respondents.

1.5.1 Conditional Cash Transfer (CCT)

I examine the effect of cash incentives on vaccination take-up to see if they can compensate for monetary costs of clinic visit. Using random variation of the amount of cash incentives, I find a strong positive effect of cash incentives on vaccination take-up. The effect of CCT was stronger among those with higher monetary costs.

Specification

To identify if cash incentives increase vaccination take-up in a regression framework, I estimate:

$$Y_{ij} = \alpha + \beta_1 CCT300_{ij} + \beta_2 CCT800_{ij} + X_{ij}{}'\mu + \epsilon_{ij} \tag{1.1}$$

where Y_{ij} is the individual outcome: whether a woman i in village j received a vaccination. $CCT300(800)$ is a dummy variable which takes 1 if the amount of the cash transfer was 300 (800) naira while its comparison group is the lowest amount of cash transfer (CCT=5). The condition for cash incentives (clinic attendance or vaccination) and the information type ("scared straight" or "control" flipchart) was controlled for in this specification. A vector of controls X includes individual-level covariates of age, age squared, the highest education attained, marital status, religion (Muslim or not), past tetanus-vaccination experience, whether the respondent has a paid work, past utilization of the health clinic, distance to health clinic, whether she has a child and village dummies. Standard errors are clustered by village, for 80 villages.

Strong Effect of CCT

Vaccination take-up was highly responsive to financial incentives. The effect of the medium CCT on vaccination take-up is 19.4 percentage points and the effect of the highest CCT is 27.7 percentage points as compared to vaccination take-up under the lowest amount of CCT (5 naira), 55.8 percent (Table 1.2 column 1).

This effect is very large, even compared to a similar program. The CCT effect found in my study is comparable with the effect of an in-kind transfer program in Banerjee et al. (2010): the conditional in-kind transfer (equivalent to about $2.9 or around 435 naira in Nigerian currency) increased the rate of full immunization by 21 percentage points in rural India, although it did not increase one-time vaccination. In addition to the small in-kind transfer, there were other factors in their study that were considered to attribute to a very large treatment effect. First, the study area from Banerjee et al. faced an extremely low vaccination rate before the intervention; the baseline vaccination rate was only 6 percent, which made it easier for the intervention to have a larger effect. Also, respondents under their study faced almost no transportation cost as the immunization camp was set inside the village. Even without having such additional factors, CCT in my study had a similar-sized effect to the program from Banerjee et al.

Because the monetary incentive was to compensate for the monetary costs of visiting the clinic such as transportation costs and opportunity costs, I look at the differential effect of CCT by transportation costs and total costs of clinic visit.[13] First, the relationship between the transportation costs and clinic attendance is negative. Specifically, if the transportation costs were positive and less than 200 naira, it reduced the attendance by 11.1 percentage points. Transportation costs between 200 naira and 300 naira reduced the attendance by 11.8 percentage points (Table 1.2 column 2). A similar relationship was observed between total costs (transportation costs and opportunity costs) and clinic attendance.

The effect of CCT was stronger among respondents who have non-zero but not-large transportation costs. Particularly, if the transportation costs were positive but less than 200 naira, then the effect of the medium amount of CCT (300 naira) was 10.1 percentage points larger than when the transportation costs was zero. Similarly, the effect of 800 naira was 11.9 percentage points larger if the transportation costs were positive but less than 200 naira (Table 1.2 column 2) and it was 12.5 percentage points larger if transportation costs was between 200 naira and 300 naira. This implies that transportation costs are one of barriers that obstructs one from attending the clinic, and CCT compensates for transportation costs if they are not large. A similar but stronger trend is observed for total costs of clinic visits.[14]

[13] Total costs of clinic visit were calculated as the summation of transportation costs and opportunity costs. Opportunity costs are calculated based on the daily household income, how much each respondent contributes to the household income, and the time it takes to visit the clinic.

[14] On the other hand, I found that the effect of CCT was not affected by the distance to the clinic. First, the relationship between the distance to the clinic and the clinic

In addition to increasing the likelihood of attending the clinic, CCT also changed the mode of transport. Table 1.3 presents that the higher amount of CCT shifted the mode of transport to more expensive one. Among respondents who attended the clinic, 800 naira reduced the likelihood of visiting the clinic on foot by 3.6 percentage points, while it increased the likelihood of going to clinic by motorcycle by 4.6 percentage points. It also increased the transportation costs by 14.5 naira. It implies that even if people attend the clinic, they are often constrained to visit the clinic with undesirable mode of transport due to high costs of alternative mode.

1.5.2 Psychic Costs of Vaccination

This section examines if psychic costs reduce vaccination take-up. Contrary to conventional wisdom from observational studies, I found that psychic costs were not the main barriers to vaccination. My study emphasizes the importance of behavioral experiments to causally examine the existence of psychic costs.

Specification

To identify if psychic costs of receiving a vaccination are barrier to vaccination in a regression framework, I estimate:

$$Y_{ij} = \alpha + \beta_1 VaccineCCT_{ij} + X_{ij}'\mu + \epsilon_{ij} \tag{1.2}$$

where Y_{ij} is the individual outcome: whether a woman i in village j attended a clinic. $VaccineCCT$=1 if the conditionality of cash transfer is

attendance was negative. The additional 1 kilometer from the health clinic reduced the likelihood of clinic attendance by 5.3 percentage points (Table not shown). While I found that the distance to clinic was a large barrier to attend the clinic, the effect of CCT on clinic attendance was not different at any distance to the clinic. This result indicates that cash incentives increase the clinic attendance in a same manner, regardless of the distance.

vaccination as opposed to clinic attendance. Information type (either "scared straight" or "control" flipchart) was controlled for in this specification. A Standard errors are clustered by village, for 80 villages.

In order to measure psychic costs of vaccination at different amount of CCT offered, I estimate:

$$\begin{aligned} Y_{ij} = \alpha + \beta_1 VaccineCCT_{ij} + \sum_{d=300,800} \gamma_d CCT_{ij} \\ + \sum_{d=300,800} \delta_d (CCT_{dij} \times VaccineCCT_{ij}) + X_{ij}{'}\mu + \epsilon_{ij} \end{aligned} \tag{1.3}$$

I allow the differential effect of psychic costs at each amount of CCT because the different types of respondents might attend clinics at the different amount of CCT, and they might have different psychic costs of vaccination. For example, more of respondents who decide to attend the clinic under Clinic CCT with the lower amount of CCT might not have gone to clinic under Vaccine CCT if psychic costs cannot be overcome with the small amount of cash incentives. On the other hand, if one was offered the high amount of CCT under Vaccine CCT, CCT might compensate for psychic costs to attend the clinic, thus smaller difference in clinic attendance by the condition for cash incentives.

Ruling out Psychic Costs as Barriers

Clinic Attendance

In order to measure the effect of psychic costs of receiving a vaccination such as fear of needles or concern for the safety of vaccines, I examine if the rate of clinic attendance was different between respondents under Clinic CCT and under Vaccine CCT. Note that the attendance rate at the clinic and the vaccination rate under the Vaccine CCT were identical, as all the respondents who attended the clinic received the vaccine under the Vaccine CCT. This is because there was no benefit from attending the clinic without receiving a vaccine, as they cannot get a cash transfer or the vaccine by simply attending the clinic.

I find that the clinic attendance was not different between respondents under different condition for cash incentives: Clinic CCT and Vaccine CCT (Figure 1.2). Overall attendance at the clinic was 74.3 percent under the Clinic CCT, while it was 74.8 percent under the Vaccine CCT. Table 1.4 (column 1) presents the effect of the vaccine condition on clinic attendance as compared to clinic attendance condition. On average, the attendance rate at health clinics under Vaccine CCT was not different from the one under the Clinic CCT in terms of value as well as significance level. Thus, it indicates that psychic costs are not the significant barriers that hinder one's vaccination. Although observational studies have emphasized psychic costs as major barriers to vaccination, this result surprisingly revealed otherwise.

Table 1.4 (column 3) presents the differential effect of condition for cash incentives on clinic attendance by the different amount of CCT. This is because women who choose to attend the clinic at each amount of cash incentives might have different extent of psychic costs. However, I found that the condition of cash incentives did not result in significant differences in clinic attendance at any amount of CCT. Psychic costs of vaccination are not the larger barrier for any women who could be influenced to attend the clinic with 800 naira or less.[15]

In order to reassure that psychic costs are not the major barriers to vaccination, I provide other possible interpretations of the same clinic attendance under Clinic CCT and under Vaccine CCT that I will eliminate. The first possibility is that respondents did not understand the clinic attendance condition correctly and misunderstood that they had to receive the vaccine in order to receive the cash compensation. In such a case, clinic attendance

[15]Because clinic attendance under 800 naira, CCT is 86.6 %, this paper does not address if psychic costs of vaccination are large barriers among the remaining 13.4 % of respondents who never showed up at the clinic.

would be identical under the two conditions. However, this scenario was less likely because this would not have happened unless all the respondents under the Clinic CCT misunderstood the condition for cash incentives.

I further show two pieces of evidence that suggest respondents understood the conditionality. First, the proportion of respondents who rejected the vaccine was higher on the first day of the project in each village than on successive days; the rejection rate on the first day in each village was, on average, 2.8 percent while the rate on successive days was 0.8 percent. If respondents did not understand the condition under Clinic CCT and they misunderstood that they were required to receive a vaccine in order to obtain cash incentives, the rejection rate on the first day should have been lower than that on successive days and it would have got higher overtime as respondents learned the conditionality correctly and refused the vaccination under Clinic CCT. Second, it is unlikely that all the respondents misunderstood the conditionality because each interviewer was trained carefully, with particular attention to the importance of clearly explaining the conditionality to respondents. Table A1.1 confirms that each interviewer had at least one respondent who rejected vaccination under the Clinic CCT. It indicates that respondents generally understood the clinic conditionality, which each interviewer explained. Thus, it is unlikely that respondents under Clinic CCT misunderstood the conditionality, although there is no direct evidence to prove it.

The second possibility is that respondents did not differentiate psychic costs of vaccine from psychic costs of clinic attendance. It is possible that a respondent did not trust health services, including vaccinations. However, I claim that this possibility is less likely because respondents under the "Clinic Visit" conditionality did not have to use any services at the health clinic, nor did they have to interact with the health staff. Non-health workers were hired to interact with respondents at each health clinic who attended the clinic. Health workers interacted with respondents only when they accepted to receive a vaccination.

In order to illustrate that the high correlation between psychic costs of clinic visits and psychic costs of vaccination could lead to the same clinic attendance rate between Clinic CCT and Vaccine CCT, I introduce a simple model of clinic attendance. Assume that net benefits of attending a clinic but not receiving a vaccine is B_h under Vaccine CCT where B_h is net psychic benefits of clinic visit, while it is $B_h + \tau$ under Clinic CCT where τ is cash incentives. Net benefits of attending a clinic and receiving a vaccine is $B_h + \tau + B_v$ under both Clinic CCT and Vaccine CCT, where B_v is the net psychic benefits of vaccination. I further assume that net benefits of not attending a clinic is zero. Then, a respondent decides to attend the clinic and receive a vaccine if

$$\begin{aligned} UnderClinicCCT: B_h + \tau + B_v > 0 \; and \; B_h + \tau + B_v > B_h + \tau \\ UnderVaccineCCT: B_h + \tau + B_v > 0 \; and \; B_h + \tau + B_v > B_h \end{aligned} \tag{1.4}$$

While she will attend the clinic without receiving a vaccine if

$$\begin{aligned} UnderClinicCCT: B_h + \tau > 0 \; and \; B_h + \tau > B_h + \tau + B_v \\ UnderVaccineCCT: B_h > 0 \; and \; B_h > B_h + \tau + B_v \end{aligned} \tag{1.5}$$

Figure 1.3 draws a simple graph to show how psychic costs of clinic attendance and psychic costs of vaccination interact to affect the decision to attend the clinic and receive a vaccine. The shaded area in blue captures respondents who go to clinic under Clinic CCT but do not go under Vaccine CCT. The shaded area in green represents respondents who receive a vaccine under Vaccine CCT but reject a vaccine under Clinic CCT at the clinic. Because the amount of CCT varies from very low (5 naira) to relatively high

(800 naira), the proportion of respondents who are in the shaded areas would be different by the amount of CCT. Namely, if people are distributed equally across the space, more respondents with higher psychic costs of health clinic will accept to visit the clinic without vaccination under Clinic CCT as the amount of cash incentives increase, while less people go to clinic without vaccination under Vaccine CCT.

Here I examine the possible distribution of respondents. Because I found that the clinic attendance was not different by the condition for cash incentives at any amount of CCT offered although the higher amount of CCT attracted more respondents for clinic attendance, respondents should be either above of shaded area in blue, or at the right of shaded areas (Figure 1.3). However, the distribution should not be above blue-shaded area because the refusal rate of vaccination at the clinic was the same by the condition for cash incentives at any amount of CCT, which should have been different if respondents spread across the green-shaded area (Table 1.4 column 5). Thus, respondents are at the right of shaded area in blue and the distribution is spread across $-\tau$ slope line. From this analysis, it should be the case that psychic costs of vaccination among respondents are low, B_h and B_v are positively correlated, or both.

Overall, I find no evidence that psychic costs are the large barriers to vaccine take-up. However, it is important to note that this study does not address psychic costs among those who never attended the clinic even at the highest amount of CCT offered (less than 15 percent of the total sample). Nonetheless, this result is surprising because it is contrary to the conventional wisdom from observational studies that states that psychic costs obstruct people from getting vaccinated to a great extent.

Vaccination take-up

In addition to clinic attendance, I also examined the difference in vaccination take-up and found that almost all respondents who attended the clinic under Clinic CCT decided to receive a vaccine, although receiving a vaccine was not necessary for them to get cash incentives. This reassures that psychic costs are not the large barriers to vaccination.

Among 825 respondents who were offered any amount of cash incentives under the Clinic CCT which did not require vaccination, there were only 26 women who refused to receive the vaccine upon their attendance at the assigned health clinic. In other words, 95.7 percent of women received vaccination although vaccination was not required for cash rewards. Table 1.4 (column 2) shows that the difference in vaccination take-up between two conditions is merely 3.4 percentage points. This result reinforces the fact that the psychic cost of vaccination was not significant, because they did not need additional incentives to receive a vaccine once they attended the clinic. Although women may have psychic costs at clinic, it was only to a very small extent.

Here, I provide possible reasons why the vaccination rate is different by the condition for cash incentives. One possible reason to reject the vaccine under Clinic CCT but not under Vaccine CCT is psychic costs of vaccination, which is the focus of this study. Another possibility is the low perceived benefit of vaccination. If an individual is indifferent between receiving a vaccine and not receiving a vaccine, then she may choose not to receive it. This can make a difference in vaccination take-up under two conditions, Clinic CCT and Vaccine CCT, because women under Clinic CCT might not receive the vaccination because they can receive the money even without vaccination, while women would receive the vaccination under the Vaccine CCT as it is a necessary condition to receive the cash compensation. Thus, the vaccination take-up is expected to be lower under the Clinic CCT than under the Vaccine CCT due to psychic costs of vaccination as well as the low perceived benefit of vaccination.

Third possibility for why the vaccination rate might have been different under the two conditions is selection. It is possible that women with different characteristics self-select to attend the clinic under the Clinic CCT and under the Vaccine CCT, which might lead to the difference in vaccination acceptance. Table A1.2 presents the difference in characteristics among women who attended the clinic under each condition for cash incentives. Characteristics listed in the table had no differences between two conditions. The self-selection into clinic attendance is less likely to cause the difference in vaccination take-up. Finally, it is possible for respondents to refuse vaccination if it takes time to receive one. However, the marginal (physical) cost of receiving a vaccination at the clinic in this study setting was almost zero because the additional time required for receiving the vaccine was only a minute or two, and respondents who wished to receive the vaccine did not have any additional processes to go through as compared to those who did not want the vaccine.

Descriptive studies can be deceiving, because the finding from my randomized experiment contradicts with the observation from the descriptive study. In addition to the experiment to derive the psychic costs of vaccination, I collected data on reasons of non-vaccination among those who had never received a vaccine prior to the study, as well as reasons why respondents had never taken their children for vaccination if they had not previously done so (Table A1.3). While the largest proportion of respondents listed lack of awareness as a main reason of non-vaccination for themselves (36.9 %), psychic costs such as fear of side effects and fear of injection were the second main reason (17.4 %). Similarly, psychic costs were the main reason for children's non-vaccination together with supply-side problems, such as insufficient supply of vaccines. Unlike the results from this experiment, these figures can mislead us to conclude that psychic costs of vaccination are the main barriers to vaccination. However, my experiment reveals that these costs do not obstruct one from vaccination even if they might exist. My study highlights the importance of behavioral experiments to causally identify the effect of psychic costs on vaccine take-up.

Overall, results exhibit that women do not face large psychic costs of receiving a vaccination. Although they may have such costs especially at the health clinic, these psychic costs are observed to be very small or easy to overcome with the small amount of cash incentives. Psychic costs of vaccination do not seem to be the major problem that prevents women from vaccination.

1.5.3 Priming about Disease Severity

This section examines the effect of priming about disease severity on vaccination take-up. Although the previous section found that psychic costs are not the main barriers to vaccination, the priming intervention potentially influences the broader population by emphasizing the importance of vaccines through increasing perceived costs of disease. I found that priming increased the perceived severity of disease, but it did not increase the vaccination take-up.

Specification

To identify if priming about disease severity increases vaccination in a regression framework, I estimate:

$$Y_{ij} = \alpha + \beta_1 VaccineCCT\&Fear_{ij} + X_{ij}'\mu + \epsilon_{ij} \tag{1.6}$$

where Y_{ij} is the individual outcome: whether a woman i in village j received a vaccination. $VaccineCCT\&Fear$=1 if a respondent i was shown the "scared straight" flipchart, as compared to control flipchart. The condition for cash incentives (Clinic CCT or Vaccine CCT) was controlled for in this specification. All the respondents under "scared straight" flipchart were offered cash incentives under Vaccine CCT. Standard errors are clustered by village, for 80 villages.

Similar to the previous section, I also measure the differential effect of priming by the amount of CCT offered:

$$\begin{aligned} Y_{ij} = \alpha + \beta_2 VaccineCCT\&Fear_{ij} + \sum_{d=300,800} \gamma_d CCT_{ij} \\ + \sum_{d=300,800} \phi_d (CCT_{dij} \times VaccineCCT\&Fear_{ij}) + X_{ij}{}' \mu + \epsilon_{ij} \end{aligned} \tag{1.7}$$

This is to examine if there is a complementarity or substitution effect between cash incentives and priming intervention.

No Priming Effect on Behavior

Vaccination take-up

Priming did not increase vaccination. The priming about disease severity rather reduced vaccination take-up by 2.5 percentage points, but the effect was statistically insignificant (Table 1.5 column 1). Similarly, the interaction terms between priming intervention and any amount of CCT are insignificant (Table 1.5 column 3). This suggests that the priming intervention was not effective in promoting vaccination at any amount of cash incentives offered.

Although priming did not induce vaccination behavior, it altered the perceived severity of disease. Table 1.6 shows that if a respondent was shown a "scared straight' flipchart, they were likely to believe that 2.53 more people would die from tetanus out of a hypothetical 100 people than respondents who were shown a control flipchart would. "Scared straight" flipcharts also increased the probability that a respondent felt very worried about tetanus, felt that tetanus was very bad, and felt that it was very important to be protected from tetanus more than control flipcharts did by 14.3, 13.8, and 10.4 percentage points. I also found that women who were shown the "scared straight' flipchart were more likely to feel frightened, tense, nervous, and uncomfortable than those who were shown the control flipcharts (Table A1.4). This is the evidence that priming was salient enough to induce an increase in net perceived benefits of vaccination.

Using objective measures of emotional response to the priming intervention, I also found that "scared straight' flipcharts induced the emotional response. Priming increased heart rate by 6.27 beats per minute more than control flipcharts did (Table 1.6 column 7). This proves that the priming intervention influenced respondents' emotion, although it did not change the behavior.

There are several possible reasons why priming failed to change vaccination behavior even though it increased the perceived severity of tetanus. One possibility is that the "scared straight" message increased perceived costs of disease only among respondents who would have received a vaccine even without the "scared straight" message. However, this possibility is less likely because I found that the "scared straight" message increased perceived disease severity especially among women who had low perceived costs of disease at the baseline, and the perceived costs of disease were positively correlated with the likelihood of receiving a vaccine (Table not shown). Second possibility is that respondents already had a high level of perceived severity of tetanus before the intervention, and lack of the perceived severity of disease was not the binding constraint on receiving a vaccination.

Third possibility is the time effect of the intervention. For example, it is possible that the intervention only had a temporal effect on the risk perception but such an effect vanished quickly over time so that it did not affect vaccination behavior. It is also possible that the interval from the time each respondent received the priming intervention to the time when she had to decide if she wanted the vaccine was too short to affect the actual vaccination. However, this study is not able to directly test these possibilities.

Overall, results indicated that priming about disease severity increased the perceived severity of tetanus, but it did not enhance vaccination take-up at least in the short-term.

Timing of Clinic Visit

This section examines how priming about disease severity affected the timing of clinic visit. Timing is an important variable to analyze because it could potentially affect the decision process for receiving a vaccination, although it did not change the overall decision to vaccinate. I examine if priming hastened or delayed the respondents' visit to the clinic through increasing the perceived severity of disease.

In order to examine the timing of clinic attendance, I estimate the Cox proportional hazard model:

$$\gamma_c(t|z_i(t)) = \gamma_0(t)exp(z_i(t)'\beta) \tag{1.8}$$

where $\gamma_c(t|z_i(t))$ is the individual hazard rate, $\gamma_0(t)$ is the baseline hazard rate, t is the time when a respondent i attended a clinic, and $z_i(t)$ is the set of individual variables.

"Scared straight' flipcharts neither hastened nor delayed women's attendance at clinic on average with or without cash incentives (Table 1.5 column 2 and 4). The likelihood of a respondent to attend a health clinic by a particular time was the same between both groups: Vaccine CCT and Vaccine CCT & Fear. This result is consistent with the effect of the priming on vaccine take-up. The intervention had no effect on behavioral change, both on the decision as well as on the process through which one reached the decision.

Although priming did not change the timing of clinic attendance among the total sample, it did affect the timing among those who attended the clinic (Table 1.5 column 5).[16] Under the lowest amount of cash incentives, "scared straight" message delayed one's clinic visit by 27 percentage points while higher amount of CCT compensated for the delay of clinic visit. If the priming intervention was associated with the medium or the highest amount of CCT, then the timing of one's clinic visit was no longer different from one under control message. Rather, the combination of the highest cash incentives and priming intervention hastened one's visit, although cash incentives without priming rather delayed the visit. This result is consistent with findings from some of previous studies (Myerson and Green, 1995; Rachlin et al., 1991).

1.5.4 Sub-group Analysis

In this section, I analyze the differential effect of psychic costs and of priming effect by the type of respondents. Specifically, I focus on the respondent's experience with tetanus-toxoid vaccination and pregnancy status. Past vaccination behaviors and the current pregnancy status might form specific perceptions of benefits and costs of vaccination which could then affect attitudes toward vaccination. I found that among women without previous experience of tetanus vaccination, psychic costs were larger at the clinic and the priming backfired on their vaccination behavior due to low perceived severity of disease and low efficacy of vaccine.

Past Tetanus Vaccination Take-up

Psychic costs of vaccination might differ by types of people, and the past vaccination decision might have reflected the psychic costs. For example, if one has never received tetanus-toxoid vaccination before (non-experienced),

[16]Remember that among women whose condition for cash incentives was vaccination, none refused vaccination once they attended the clinic. Thus, I treat "the timing of clinic attendance" in the same way as "the timing of vaccination".

this might be due to the high psychic costs of receiving a vaccination. On the other hand, these psychic costs might not be barriers for those who received vaccination but never completed the vaccination series (one-time experienced).

I found that while one-time experienced women did not face psychic costs (Table A1.5 column 2 and 5), non-experienced women had a stronger psychic costs of receiving a vaccination than average women at the clinic (Table A1.5 column 1 and 4). Although the clinic attendance was the same under the different condition for cash incentives (Clinic CCT and Vaccine CCT) both among non-experienced and among one-time experienced, vaccination rate was lower under Clinic CCT among non-experienced women by 5.5 percentage points. I confirmed that this difference in vaccination take-up among non-experienced is not due to the difference in characteristics among women who attended the clinic (Table A1.6). On the other hand, there was no difference in vaccination take-up by the condition for cash incentives among one-time experienced women.

It is important to examine the effect of interventions on vaccination take-up especially among non-experienced women because they are the priority in the policy. The effect of CCT was the same for all the women regardless of the past experience of tetanus vaccination (Table not shown). On the other hand, I found that the effect of priming on vaccination among non-experienced women was negative; priming about disease severity reduced vaccination by 3.9 percentage points (Table A1.5 column 4) even though it increased the perceived severity of tetanus (Table A1.7 panel A). Fear appeals literature suggests that fear appeals can have an adverse effect if the perception of risk of contracting the disease and perceived vaccine efficacy that respondents face is low (Caplin, 2003). In fact, Table A1.8 presents evidence that the non-experienced women were actually less likely to believe that they were at the risk of contracting tetanus.

Pregnancy
Since this study emphasized the importance of vaccinations for pregnant women, pregnant women may have had different response to interventions from other women. However, I did not find any differential effect of interventions for pregnant women. I found that psychic costs of vaccination among pregnant women was not the large barrier and that the priming effect was not effective in promoting vaccination behavior. (Table A1.5 column 3 and 6). The priming intervention did not increase the perceived severity of tetanus much (Table A1.7 panel C). This might be because the pregnancy already made the women sufficiently cautious about any disease risk that could affect the baby.

1.6 Conclusion

This study uses a field experiment in rural northern Nigeria to examine the relative importance of various potential barriers to vaccine take-up by evaluating the causal effect of monetary costs, psychic costs, and priming about disease severity. I find that psychic costs of vaccination are not the major barriers to vaccination contrary to conventional wisdom. Cash incentives increase vaccination take-up significantly by relaxing the monetary costs of clinic visits such as transportation costs. Priming about disease severity does not increase vaccination take-up but it increases perceived costs of the disease.

My paper contributes to a better understanding of the barriers to vaccination, particularly by examining the causal effect of psychic costs which have been considered as a major barrier without a causal examination. I highlighted the importance of behavioral experiment to study psychic costs because my experimental design reveals no such costs, which is contradictory to what observational studies have claimed.

I also contribute to literature of other channels of vaccination behaviors. First, I contribute to the literature on CCTs because my study accurately measures the effect of CCT with a single conditionality and finds a strong influence on vaccination take-up, while previous studies only used CCT with multiple conditionalities and found a weak result on vaccination take-up. Second, I contribute to priming literature because I used improved measures of outcome variables to examine priming effect in Africa for the first time: actual vaccination take-up as well as the objective measure of perceptions, heart rate.

Although this study produced new insights on vaccination behavior, there are limitations in my study. First, this study does not address the psychic costs among those who did not attend the clinic even when they were offered the highest amount of cash incentives. They might be the ones who have larger psychic costs of vaccination. Second, this paper does not generalize the findings on vaccination behavior by other groups of people such as males, children and elders, because the sample is restricted to women of childbearing age or pregnant women. Third, the study only looked at the effect of intervention on one-time vaccination take-up. Tetanus-toxoid vaccines as well as other recommended vaccines such as OPV and DPT are required to be taken multiple times to have the sufficient protective effect. However, this study did not examine the persistent effect of intervention on take-up of multiple doses.

Further studies need to assess the potential larger psychic costs among women who did not attend the clinic even at the high cash incentives. One way to address this is to offer vaccinations at each household of the respondent. This can eliminate the possible correlation between psychic costs of vaccination and psychic costs of clinic visits to accurately identify psychic costs of vaccination among general population. Additionally, the future research needs to be done in order to identify what type of information, such as the information on vaccine availability and on vaccination schedule, is effective in increasing vaccine take-up.

References

Abdulraheem, S., Onajole, T., Jimoh, G., and Oladipo, R. (2011). Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *Journal of Public Health and Epidemiology*, 3(4).

Abhyankar, P., O'Connor, B., and Lawton, R. (2008). The role of message framing in promoting MMR-vaccination: Evidence of a loss-frame advantage. *Psychology, Health and Medicine*, 13(1).

Adelekan, M. and Lawal, R. (2006). Drug use and HIV infection in Nigeria: A review of recent findings. *African Journal of Drug and Alcohol Studies*, 5(2).

Banerjee, A., Duflo, E., Glennerster, R., and Kothari, D. (2010). Improving immunization coverage in rural India: A clustered randomized controlled evaluation of immunization campaigns with and without incentives. *British Medical Journal*, 340(c2220).

Barham, T. and Maluccio, J. (2009). Eradicating disease: The effect of Conditional Cash Transfers on vaccination coverage in rural Nicaragua. *Journal of Health Economics*, 28(3).

Blencowe, H., Lawn, J., Vandelaer, J., Roper, M., and Cousens, S. (2010). Tetanus toxoid immunization to reduce mortality from neonatal tetanus. *International Journal of Epidemiology*, 39.

Bloom, D., Canning, D., and Weston, M. (2005). The value of vaccination. *World Economics*, 6(3).

Brenzel, L., Wolfson, J., Fox-Rushby, J., Miller, M., and Halsey, A. (2006). Vaccine-preventable diseases. *World Bank*, 20.

Buor, D. (2003). Analysing the primacy of distance in the utilization of health services in the Ahafo-Ano South district, Ghana. *International Journal of Health Planning and Management*, 18(4).

Caplin, A. (2003). Fear as a policy instrument: Economic and psychological perspectives on intertemporal choice. *Russell Sage Foundation*.

Chaudhury, N., Hammer, J., Kremer, M., Muralidharan, K., and Rogers, F. (2004). Teacher and health care provider absenteeism: A multi-country study. *World Bank*.

Commission, N. P. and Macro, I. (2009). Nigeria demographic and health survey 2008. *National Population Commission and ICF Macro*.

Currie, J. (2006). The take-up of social benefits. *Russell Sage*.

Deacon, D. and Abramowitz, J. (2006). Fear of needles and vasovagal reactions among phlebotomy patient. *Journal of Anxiety Disorders*, 20(7).

Dillard, P. and Anderson, W. (2004). The role of fear in persuasion. *Psychology and Marketing*, 21(11).

Dupas, P. (2011a). Do teenagers respond to hiv risk information? evidence from a field experiment in Kenya. *American Economic Journal: Applied Economics*, 1.

Dupas, P. (2011b). Health behavior in developing countries. *Annual Review of Economics*, 3.

Ehreth, J. (2003). The global value of vaccination. *Vaccine*, 21.

Essen, G. V., Kuyvenhoven, M., and R. De Melker, R. (1997). Why do healthy elderly people fail to comply with influenza vaccination? *Age and Ageing*, 26.

Fritsche, G., Soeters, R., and Meessen, B. (2014). Performance-based financing toolkit. *World Bank*.

Gauri, V. and Khaleghian, P. (2002). Immunization in developing countries its political and organizational determinants. *The World Bank Development Research Group Policy Research Working Paper*, (2769).

Gerend, M. and Shepherd, J. (2007). Using message framing to promote acceptance of the human papillomavirus vaccine. *Health Psychology*, 26(6).

Gertler, J. (2004). Do conditional cash transfers improve child health? evidence from PROGRESA control randomized experiment. *American Economic Review*, 94.

Goldberg, A. (2014). Immunization decisions in rural northern nigeria. *Dissertation at Columbia University*.

Goldstein, M., Zivin, G., Pop-Eleches, J. H. C., and Thirumurthy, H. (2013). The effect of absenteeism and clinic protocol on health outcomes: The case of mother-to-child transmission of HIV in Kenya. *American Economic Journal: Applied Economics*, 5(2).

Grossman, M. (2000). The human capital model. *Handbook of health economics*.

Harris, C. (2010). Feelings of dread and intertemporal choice. *Journal of Behavioral Decision Making*, 25(1).

IRIN (2013). Analysis roots of polio vaccine (april 4, 2013). roots of polio vaccine suspicion. *IRIN News*.

Jepson, C. and Chaiken, S. (1990). Chronic issue-specific fear inhibits systematic processing of persuasive communications. *Journal of Social Behavior and Personality*, 5.

Jheeta, M. and Newell, J. (2008). Childhood vaccination in Africa and Asia: the effects of parents' knowledge and attitudes. *Bulletin of the World Health Organization*, 86(6).

Job, S. (1988). Effective and ineffective use of fear in health promotion campaigns. *American Journal of Public Health*, 78(2).

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica*, 47.

Kaufmann, J. and Feldbaum, H. (2009). Diplomacy and the polio immunization boycott in northern Nigeria. *Health Affairs*, 28(4).

Kimmel, S., Burns, T., and Zimmerman, R. (2007). Addressing immunization barriers, benefits, and risks. *Journal of Family Practice*, 56(3).

Kreuter, M. and Strecher, V. (1995). Changing inaccurate perceptions of health risk: Results from a randomized trial. *Health Psychology*, 14(1).

Lagarde, M., Haines, A., and Palmer, N. (2009). The impact of conditional cash transfers on health outcomes and use of health services in low and middle income countries. *Cochrane Database of Systematic*, 4(CD008137).

Meessen, B., Soucat, A., and Sekabaraga, C. (2011). Performance-based financing: just a donor fad or a catalyst towards comprehensive health-care reform? *Bulletin of the World Health Organization*, 89.

Middaugh, P. (1979). Side effects of diphtheria-tetanus toxoid in adults. *American Journal of Public Health*, 69.

Moran, W., Nelson, K., Wofford, J., Ramon, V., and Case, D. (1996). Increasing influenza immunization among high-risk patients: Education or financial incentive? *American Journal of Medicine*, 101(6).

Morris, S., Flores, R., Olinto, P., and Medina, J. (2004). Monetary incentives in primary health care and effects on use and coverage of preventive health care interventions in rural honduras: cluster randomised trial. *Lancet*, 9450(4).

Myerson, J. and Green, L. (1995). Discounting of delayed rewards. *Journal of the Experimental Analysis of Behavior*, 64.

Nichter, M. (1995). Vaccinations in the third world: A consideration of community demand. *Social Science and Medicine*, 41(5).

Nyhan, B., Reifler, J., and Richey, S. (2014). Effective messages in vaccine promotion: a randomized trial. *Pediatrics*, 133(4).

Ogunlesi, A. (2011). Vaccines for women to prevent neonatal tetanus: Rhl commentary. *The WHO Reproductive Health Library*.

O'Keefe, D. and Nan, X. (2012). The relative persuasiveness of gain- and loss-framed messages for promoting vaccination: A meta-analytic review. *Health Communication*, 27(8).

Okwaraji, B., Cousens, S., Berhane, Y., Mulholland, K., and Edmond, K. (2012). Effect of geographical access to health facilities on child mortality in rural Ethiopia: A community based cross sectional study. *PLoS ONE*, 7(3).

Onalo, R., Ishiaku, H., and Ogala, W. (2010). Prevalence and outcome of neonatal tetanus in Zaria, northwestern Nigeria. *Journal of Infect Dev Ctries*, 26(5).

Orimadegun, A., Adedayo, A., and Olusegun, A. (2014). Adolescent girls' understanding of tetanus infection and prevention: Implications for the disease control in western Nigeria. *Frontiers in Public Health*, 2.

Oruamabo, S. (2007). Neonatal tetanus in Nigeria: does it still pose a major threat to neonatal survival? *Archives of Disease in Childhood*, 92.

Pebley, A., Goldman, N., and Rodriguez, G. (1996). Prenatal and delivery care and childhood immunization in Guatemala: Do family and community matter? *Demography*, 33(2).

Petrosino, A., Turpin-Petrosino, C., Hollis-Peel, M., J., L., and Stern, A. (2004). Scared straight and other juvenile awareness programs for preventing juvenile delinquency. *J Crime Prevention Research Revie*.

Rachiotis, G., Mouchtouri, A., Kremastinou, J., Gourgoulianis, K., and Hadjichristodoulou, C. (2010). Low acceptance of vaccination against the 2009 pandemic influenza a(h1n1) among healthcare workers in Greece. *Euro Surveill*, 15(6).

Rachlin, H., Rainieri, A., and Cross, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behavior*, 55.

Rainey, J., Watkins, M., Ryman, T., Sandhu, P., Bo, A., and Banerjee, K. (2011). Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: findings from a systematic review of the published literature, 1999-2009. *Vaccine*, 29(46).

Renne, E. (2006). Perspectives on polio and immunization in northern Nigeria. *Social Science and Medicine*, 63(7).

Robertson, L., Mushati, P., Eaton, W., Dumba, L., Mavise, G., Makoni, J., Schumache, C., Crea, T., Monasch, R., Sherr, L., Garnett, P., Nyamukapa, C., and Gregson, S. (2013). Effects of unconditional and conditional cash transfers on child health and development in Zimbabwe: a cluster-randomised trial. *Lancet,*, 381(9874).

Rothman, A. and Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychological Bulletin*, 121.

Rothman, A., Salovey, P., Antone, C., Keough, K., and Martin, C. (1993). The influence of message framing on intentions to perform health behaviors. *Journal of Experimental Social Psychology*, 29.

Salinas-Rodriguez, A. and Manrique-Espinoza, B. (2013). Effect of the conditional cash transfer program oportunidades on vaccination coverage in older Mexican people. *BMC International health and human rights*, 13(1).

Steele, F., Diamond, I., and Amin, S. (1996). Immunization uptake in rural Bangladesh: a Multilevel analysis. *Journal of the Royal Statistical Society*, A(159).

Sutherland, K., Leatherman, S., and Christianson, J. (2008). Paying the patient: does it work? A revew of patient-targeted incentives. *The Health Foundation*.

Thysen, S., Byberg, S., Pedersen, M., Rodrigues, A., Ravn, H., Martins, C., Benn, C., Aaby, P., and Fisker, A. (2014). BCG coverage and barriers to BCG vaccination in Guinea-Bissau: an observational study. *BMC Public Health*, 14(1).

Tumusiime, P., Gonani, A., Walker, O., Asbu, E., Awases, M., and Kariyo, P. (2012). Health systems in sub-saharan africa: What is their status and role in meeting the health millennium development goals? *The African Health Monitor*.

Umar, N., Hajara, M., and Khalifa, M. (2011). Reduction of client waiting time using task shifting in an anti-retroviral clinic at Specialist Hospital Bauchi, Nigeria. *Journal of Public Health in Africa*, 2(e2).

UNICEF (2001). Combatting antivaccination rumors: Lessons learned from case studies in east africa. *UNICEF*.

UNICEF (2010). Maternal and neonatal tetanus elimination initiative. *UNICEF*.

Weaver, T., Metrebia, N., Hellier, J., Pilling, S., Charles, V., Little, N., Poovendran, D., Mitcheson, L., Ryan, F., Bowden-Jones, O., Dunn, J., Glaspe, A., Finch, E., and Strang, J. (2014). Use of contingency management incentives to improve completion of hepatitis B vaccination in people undergoing treatment for heroin dependence: a cluster randomised trial. *Lancet*, 38(9938).

WHO (2006). Maternal immunization against tetanus. *WHO Standards for Maternal and Neonatal Care*.

WHO (2013). Weekly epidemiological record. *WHO*, 88.

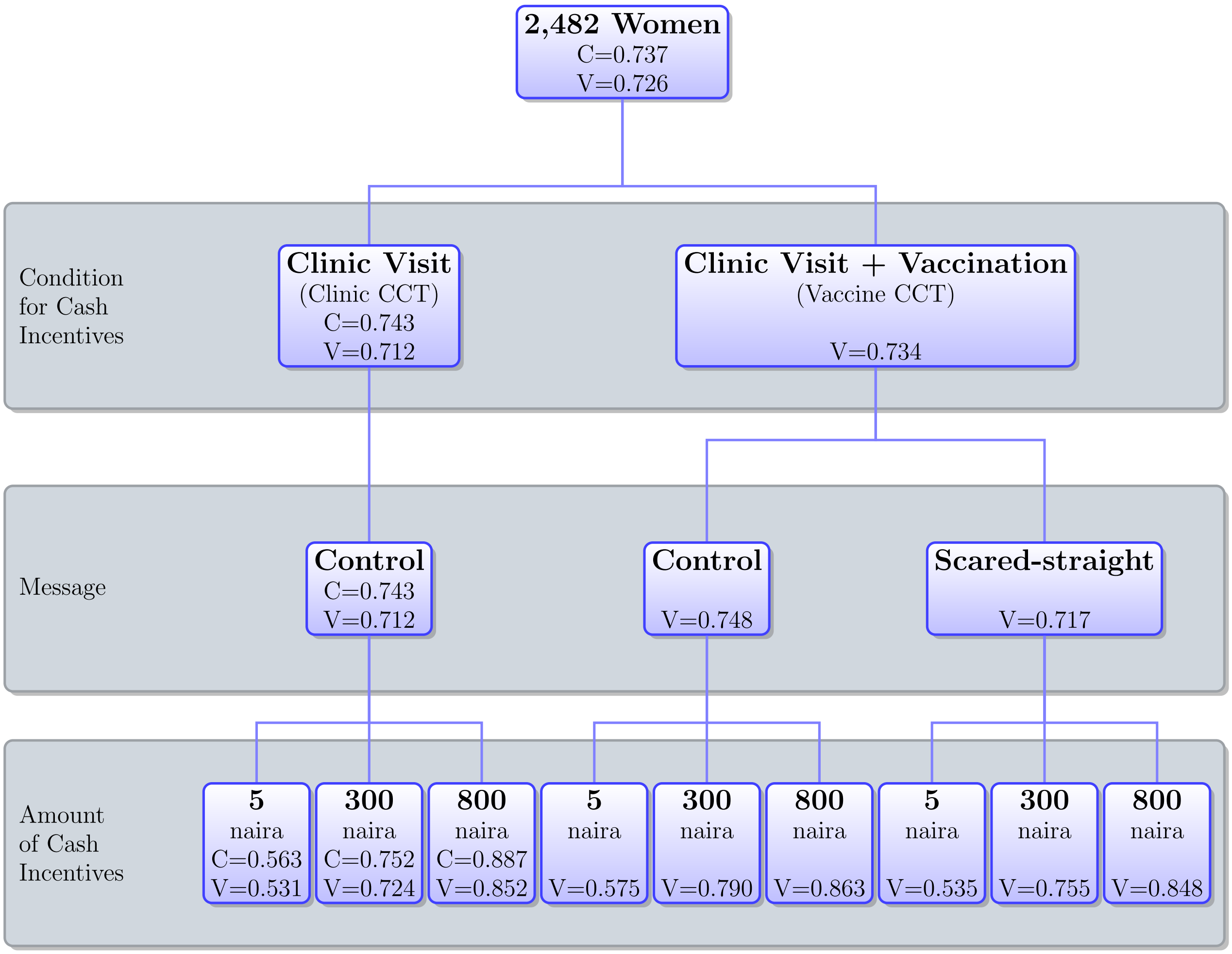
WHO (2014). Weekly epidemiological record. *WHO*, 89.

Witte, K. (1994). Fear control and danger control: A test of the extended parallel process model. *Communication Monographs*, 61(2).

Witte, K. and Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education and Behavior*, 27(5).

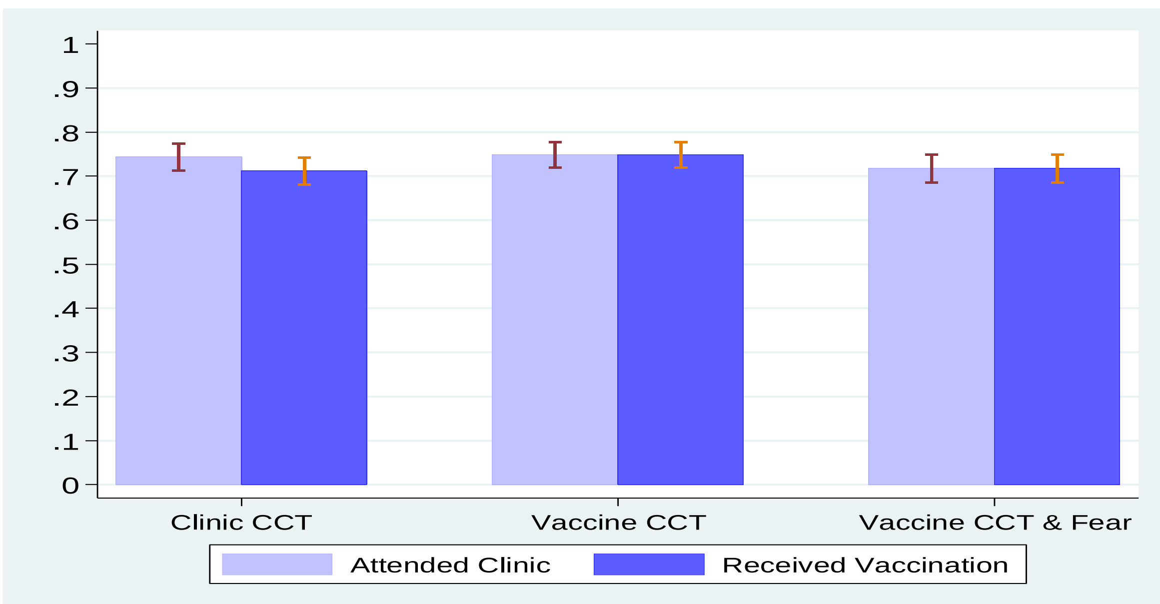
Zwane, A. and Kremer, M. (2007). What works in fighting diarrheal diseases in developing countries? a critical review. *World Bank Research Observer*, 22(1).

Zziwa, G. (2009). Review of tetanus admissions to a rural Ugandan hospital. *Health Policy and Development*, 7(3).



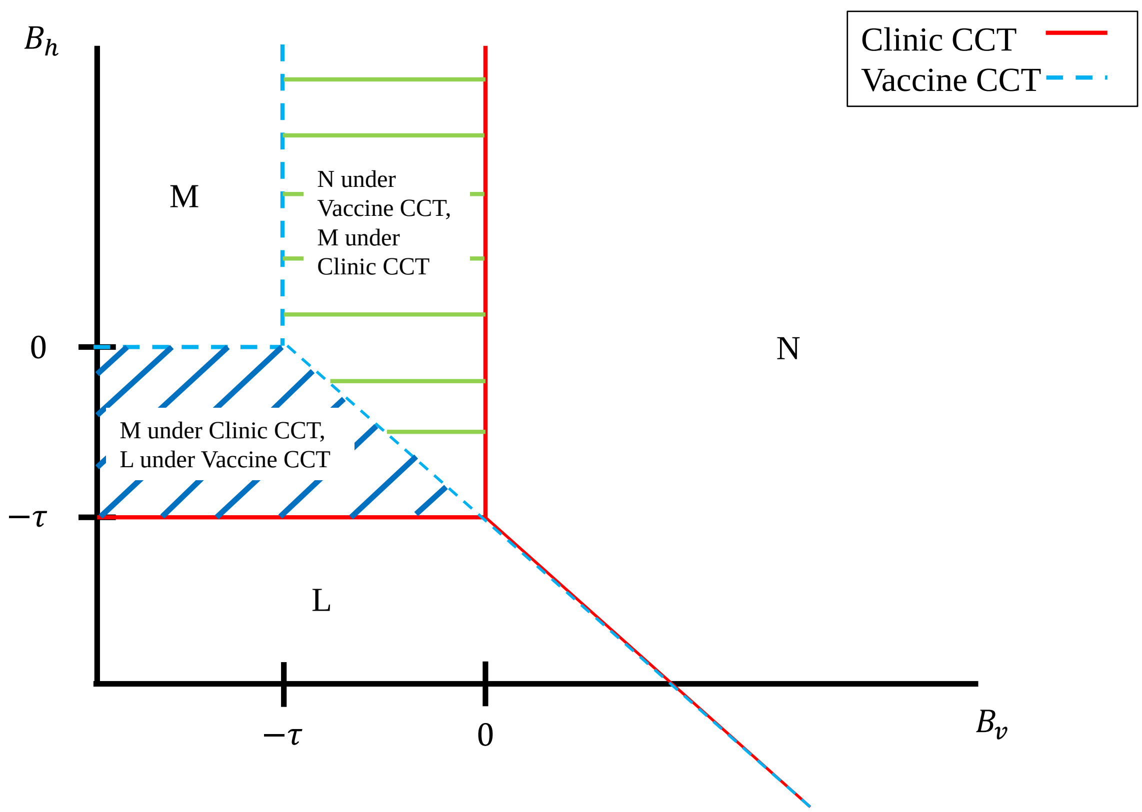
Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). 150 naira = $1 approximately. C is clinic attendance rate, and V is vaccination take-up.

Figure 1.1: Research Design



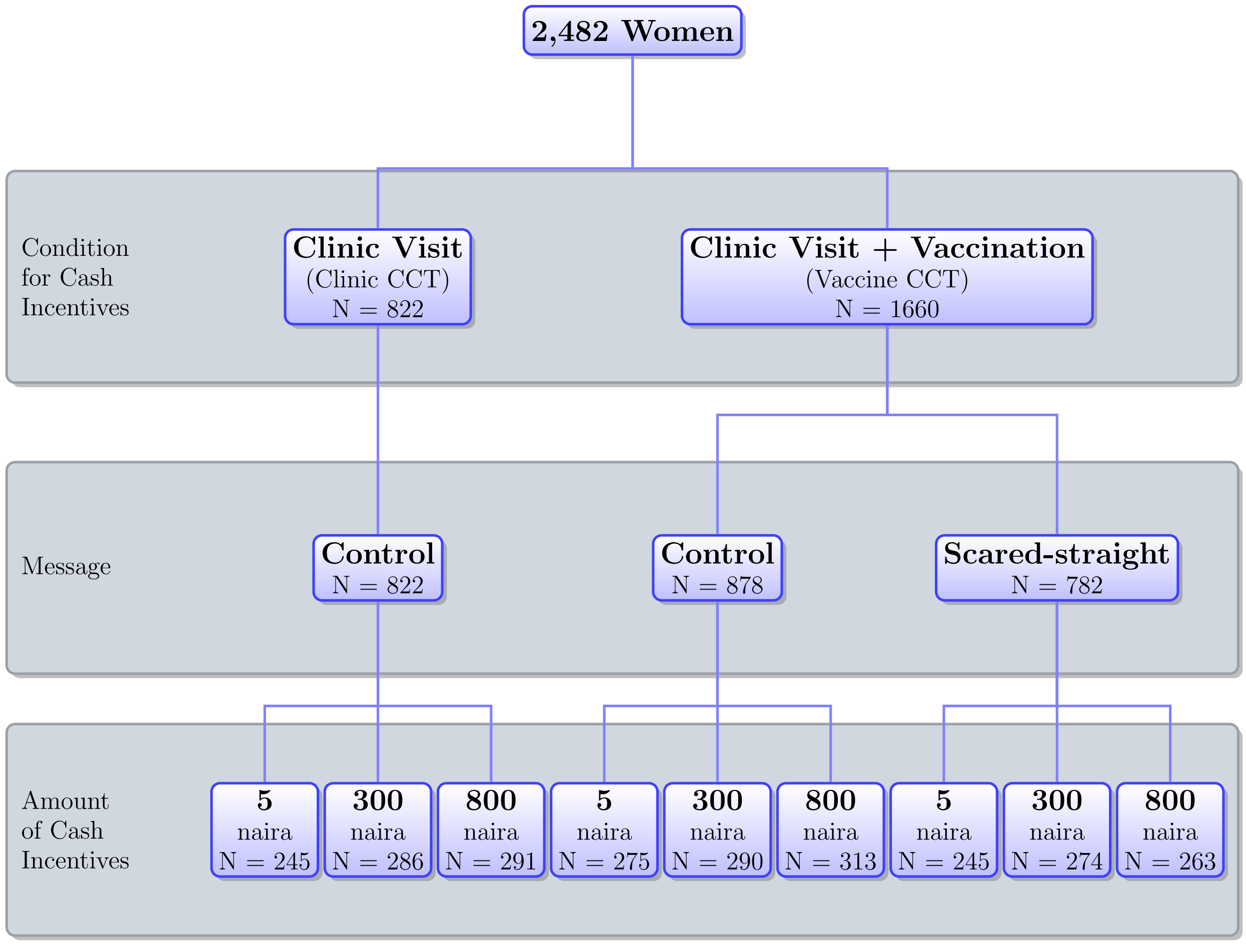
Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). Figure presents the rate of clinic attendance and vaccination at the clinic.

Figure 1.2: Clinic Attendance and Vaccine Uptake



Notes: In the area with L, women do not attend clinic. Women attend clinic but refuse a vaccine under M, and women attend clinic and receive a vaccine under N. B_v is the net psychic benefits of vaccination and B_h is the net psychic benefits of clinic visit.

Figure 1.3: Model of Psychic Costs of Vaccination



Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). 150 naira = $1 approximately. N is the number of observations.

Figure 1.4: Research Design (Number of Observation)

Table 1.1: Balancing and Summary Statistics

Panel A: Sample Size by Treatment	
Clinic CCT	822
Vaccine CCT	878
Vaccine CCT & Fear	782
CCT=5	765
CCT=300	850
CCT=800	867

Panel B: Balancing

	Condition of CCT and message				Amount of CCT			
	Clinic CCT	Vaccine CCT	Vaccine CCT & Fear	Joint significance (p-value)	CCT=5	CCT=300	CCT=800	Joint significance (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Demographics:								
Age	24.822	25.279	25.216	0.257	24.867	24.915	25.510	0.056
Muslim	0.494	0.484	0.510	0.564	0.478	0.525	0.482	0.110
Highest education = no education	0.483	0.489	0.477	0.894	0.507	0.469	0.475	0.268
Has paid work	0.423	0.442	0.440	0.705	0.424	0.452	0.429	0.471
Monthly household earning per capita (naira)	5929.064	5640.343	6083.256	0.529	5430.287	6097.71	6068.16	0.193
Marital status = Single	0.157	0.150	0.151	0.918	0.154	0.155	0.149	0.923
Currently pregnant	0.180	0.165	0.202	0.147	0.166	0.179	0.198	0.253
Have children	0.758	0.788	0.746	0.106	0.763	0.761	0.769	0.919
Ever used clinic	0.700	0.724	0.744	0.134	0.714	0.741	0.712	0.320
Distance to clinic (km)	1.717	1.697	1.712	0.943	1.721	1.675	1.730	0.621
Transport to clinic (naira)	120.125	129.118	121.004	0.593	122.648	113.676	134.059	0.107
Opportunity costs to clinic (naira)	3.913	4.028	4.278	0.661	4.350	3.765	4.116	0.849
Received tetanus vaccine before	0.384	0.410	0.400	0.556	0.401	0.394	0.400	0.949
Beliefs:								
Vaccines give HIV	0.187	0.186	0.178	0.867	0.205	0.181	0.167	0.138
Vaccines protect from disease	0.911	0.911	0.914	0.955	0.908	0.914	0.913	0.910
Needles are scary	0.589	0.641	0.616	0.049	0.634	0.604	0.612	0.438
Vaccines have side effects	0.652	0.692	0.634	0.028	0.678	0.662	0.644	0.331
Vaccines give diseases	0.253	0.288	0.270	0.237	0.281	0.268	0.264	0.730

Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). 35 out of the total sample are dropped from the neighbor-level variables because they have no neighbors within 100 meters. 150 naira = $1 approximately. Sample mean is reported in columns 1-3 and 5-7, while columns 4 and 8 report p-value for the test of equality between columns 1-3, and columns 5-7.

Table 1.2: Effect of CCT and Transpirtation Costs

Dependent variable:	Received vaccine	
	(1)	(2)
CCT=300	0.194***	0.176***
	(0.023)	(0.024)
CCT=800	0.277***	0.241***
	(0.025)	(0.030)
Transport 1		-0.111**
		(0.043)
Transport 2		-0.118**
		(0.051)
Transport 3		-0.018
		(0.060)
CCT300 * Transport 1		0.101**
		(0.049)
CCT300 * Transport 2		0.067
		(0.058)
CCT300 * Transport 3		-0.046
		(0.063)
CCT800 * Transport 1		0.119**
		(0.052)
CCT800 * Transport 2		0.125*
		(0.071)
CCT800 * Transport 3		0.004
		(0.066)
Observations	2482	2416
R-squared	0.110	0.116
Mean of Dependent Variable	0.558	0.615
Covariates	X	X
Fixed effect by village (80 villages)	X	X

Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates. Missing observations are due to missing values in GPS coordinates and transportation costs. Transport is the transportation costs which are the total costs respondents claimed required to visit the clinic (both way). Transport 0= 0 transportation cost, Transport 1= 0-200 naira of transportation costs, Transpot 2=200-300 naira of transporation costs, and Transport 3=300 naira or more of transporation costs. Control group is the group of women under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic only in (1). Mean of Dependent Variable is the mean under CCT in (1), and under CCT and transportation costs=0 under (2). * significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.3: Effect of CCT on Mode of Transport (Endline)

Dependent variables:	Walk	Bicycle	Motorcycle	Car	Transport minutes	Transport costs
	(1)	(2)	(3)	(4)	(5)	(6)
CCT=300	-0.024	0.004	0.030	0.001	-0.892	9.605*
	(0.022)	(0.003)	(0.023)	(0.007)	(2.013)	(5.524)
CCT=800	-0.036*	0.008*	0.046*	-0.006	-0.319	14.463**
	(0.021)	(0.004)	(0.023)	(0.006)	(2.123)	(6.275)
Walk at baseline	0.033					
	(0.023)					
Bicycle at baseline		-0.014				
		(0.010)				
Morocycle at baseline			0.038*			
			(0.020)			
Car at baseline				0.035**		
				(0.016)		
Observations	1829	1829	1829	1829	1829	1775
R-squared	0.003	0.004	0.005	0.004	0.000	0.008
Mean of Dependent Variable	0.815	0.000	0.169	0.014	43.199	33.005
Covariates	X	X	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X	X	X

Notes: Sample used here is the sample of 1,829 women who attended the clinic and whose household location is recorded with GPS coordinates. MIssing observations are due to missing values in transporation costs in (6). Control group is the group of women under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. Control group is the group of women under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. Mean of Dependent Variable is the mean under Vaccine CCT * significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.4: Psychic Costs of Vaccination

Sample:	All				Clinic attendee
Dependent variables:	Attended clinic	Received vaccine	Attended clinic	Received vaccine	Received vaccine
	(1)	(2)	(3)	(4)	(5)
Vaccine CCT	0.002	0.034*	-0.011	0.021	0.058**
	(0.016)	(0.018)	(0.032)	(0.036)	(0.025)
CCT=300			0.168***	0.171***	0.021
			(0.039)	(0.041)	(0.026)
CCT=800			0.284***	0.282***	0.024
			(0.038)	(0.039)	(0.021)
CCT=300 * (Vaccine CCT)			0.047	0.044	-0.019
			(0.042)	(0.046)	(0.026)
CCT=800 * (Vaccine CCT)			-0.000	0.001	-0.024
			(0.038)	(0.041)	(0.022)
Observations	2482	2482	2482	2482	1829
R-squared	0.021	0.022	0.113	0.110	0.040
Mean of Dependent Variable	0.743	0.712	0.563	0.531	0.942
Covariates	X	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X	X
p-values of F test:					
(Vaccine CCT + CCT=300 * Vaccine CCT) = 0			0.160	0.015	0.003
(Vaccine CCT + CCT=800 * Vaccine CCT) = 0			0.652	0.462	0.015

Notes: Sample used in (1) to (4) is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates) and column (5) used 1,829 women who attended the clinic. Control group is the group of women under Clinic CCT and under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. Control group is the group of women under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. The minimum detective effect size (standardized) of VaccineCCT is 0.1 with significance level 0.9 and with power of 0.8. Because the standard deviation of the outcome variable (Received Vaccine) is 0.45, the minimum detective effect size (unstandardized) is 0.045 and the effect below can be considered economically insiginificant. Mean of Dependent Variable is mean under Clinic CCT for (1) and (2), and under Clinic CCT and CCT5 for (3) to (5). * significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.5: Effect of Message Priming about Disease Severity

Sample:	All				Clinic attendee
Specification:		Hazard model		Hazard model	Hazard model
Dependent variable:	Received vaccine				
	(1)	(2)	(3)	(4)	(5)
Vaccine CCT & Fear	-0.025	-0.027	-0.010	-0.114	-0.270**
	(0.018)	(0.059)	(0.033)	(0.110)	(0.122)
CCT=300			0.215***	0.528***	-0.124
			(0.030)	(0.095)	(0.084)
CCT=800			0.282***	0.703***	-0.191**
			(0.035)	(0.097)	(0.079)
CCT=300 * (Vaccine CCT & Fear)			-0.023	0.100	0.359**
			(0.043)	(0.140)	(0.164)
CCT=800 * (Vaccine CCT & Fear)			-0.017	0.172	0.460***
			(0.043)	(0.124)	(0.170)
Observations	2482	2458	2482	2458	1806
R-squared	0.022		0.110		
Mean of Dependent Variable	0.748	0.748	0.575	0.575	1.000
Covariates	X	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X	X
p-values of F test:					
(Vaccine CCT & Fear + CCT=300 * Vaccine CCT & Fear) = 0			0.244	0.879	0.263
(Vaccine CCT & Fear + CCT=800 * Vaccine CCT & Fear) = 0			0.340	0.476	0.033

Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates) in (1) to (4). 24 out of the total sample are dropped from the hazard model because the time of clinic attandance was missing. The sample in (5) is 1,806 women who attended the clinic and has the information of the time of clinic attendance. Control group is the group of women under Vaccine CCT and under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. The minimum detective effect size (standardized) of VaccineCCT is 0.1 with significance level 0.9 and with power of 0.8. Because the standard deviation of the outcome variable (Received Vaccine) is 0.45, the minimum detective effect size (unstandardized) is 0.045 and the effect below can be considered economically insiginificant. Mean of Dependent Variable is the mean under Vaccine CCT in (1) and (2) and under Vaccine CCT & CCT5 in (3) to (5). * significant at 10%; ** significant at 5%; *** significant at 1%

Table 1.6: Did Messaging Change Perception of Tetanus? (Endline)

Dependent variables:	Likely to contract tetanus	Number of people who die of tetanus	Very worried about Tetanus	Tetanus is very bad	Very important to be protected from tetanus	Vaccine efficacy	Heart rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Vaccine CCT & Fear	0.015	2.529**	0.143***	0.138***	0.104***	-0.935	6.270***
	(0.018)	(1.175)	(0.028)	(0.026)	(0.026)	(1.351)	(0.701)
Observations	2283	2280	2283	2283	2283	2278	2091
R-squared	0.094	0.090	0.147	0.111	0.119	0.111	0.404
Mean of Dependent	0.459	37.414	0.566	0.649	0.746	43.572	87.735
Covariates	X	X	X	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X	X	X	X

Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). Missing obeservations in each specification is due to missing values and invalid numbers. Control group is the group of women under Vaccine CCT and under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. All the dependent variables indicate the measurement after the flipcharts intervention. "Likely to get tetanus" is a binary variable which takes 1 if a respondent answers as " high likelihood" to the question "what is the likelihood that you get tetanus?" "Number of people who die of tetanus" is the number of people out of 100 a respondent provided to a question "Once they have tetanus, how many people do you think would die because of Tetanus?". "Very worried about tetanus" is a binary variable which takes 1 if a respondent answers "very worried" to the question "How worried are you that you might get tetanus? Very worried, worried, not too worried, not worried at all?". "Tetanus is very bad" is a binary variable which takes 1 is a respondent answers "very bad" to the question "How bad would it be if you get tetanus? Very bad, bad, not too bad, not bad at all?". "Very important to be protected from tetanus" is a binary variable which takes 1 is a respondent answers "very important" to the question "How important is it for you to make sure that you are protected from tetanus? Very important, important, not too important, not important at all?" "Vaccine Efficacy" is the difference between hypothetical number of unvaccinated people whom each respondent thinks get tetanus and number of vaccinated people who get tetanus. "Heart rate" indicates the heart rate of a respondent measured. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic, and baseline attitudes such as likelihood of contracting tetanus, number of people the respondent thinks die out of tetanus, if the respondent is very worried about tetanus, if the respondent thinks tetanus is very bad, subjective vaccine efficacy and heart rate. Mean of Dependent Variable is mean under Vaccine CCT. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A1.1: Did Respondents Understand Clinic Conditionality?

Interviewer	Number of respondents who: Rejected vaccination	Accepted vaccination	Total
A	5	66	71
B	1	66	67
C	3	57	60
D	4	73	77
E	2	53	55
F	2	49	51
G	2	55	57
H	1	55	56
I	2	53	55
J	4	58	62
Total	26	585	611

Notes: Sample used here is 611 respondents who visited the clinic under Clinic CCT.

Table A1.2: Selection to Attend Clinic

Sample:	Clinic CCT	Vaccine CCT	Difference
	(1)	(2)	(3)
Age	25.200	25.498	-0.298 (0.341)
Muslim	0.466	0.452	0.014 (0.028)
Highest education = no education	0.456	0.464	-0.008 (0.028)
Has paid work	0.447	0.463	-0.016 (0.028)
Monthly household earning per capita (naira)	5920.8	5603.1	317.7 (435.5)
Marital status = Single	0.163	0.152	0.011 (0.020)
Currently pregnant	0.183	0.164	0.019 (0.023)
Have children	0.771	0.796	-0.025 (0.023)
Ever used clinic	0.687	0.726	-0.039 (0.026)
Distance to clinic (km)	1.598	1.569	0.029 (0.066)
Transport to clinic (naira)	115.79	116.70	-0.907 (11.03)
Opportunity costs to clinic (naira)	22.094	19.288	2.807 (2.383)
Received tetanus vaccine before	0.387	0.387	-0.000 (0.027)

Notes: Sample used here is 1,268 women who visited an assigned clinic under Clinic CCT or under Vaccine CCT. Standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A1.3: Reasons for Non Vaccination

	Main reasons respondents have not received any vaccination (1)	Main reasons respondents' children have not received any vaccination (2)
Lack of information	0.369	0.120
Psychic costs of vaccination	0.174	0.180
Post too far	0.169	0.150
Supply-side problem	0.046	0.180
Not enough money	0.031	0.077
Misconception of vaccination	0.021	0.120
No particular reason	0.169	0.133
Other	0.021	0.030

Notes: Sample used here 195 women who have never received vaccination for herself in (1), and 233 women who have never taken children for vaccination in (2). Psychic costs of vaccination include scared of injection, fear of side effect, do not like vaccination, and tradition does not allow vaccination. Supply-side problem include lack of vaccine stocks at the clinic, and health workers not visiting their villages. Misconception of vaccination include the belief that vaccination do not have to be given to healthy people, and that infants should not receive the vaccination in the first 40 days.

Table A1.4: Did Messaging Change Feeling? (Endline)

Dependent variables:	Feel frightened	Feel tensed	Feel nervous	Feel uncomfortable
	(1)	(2)	(3)	(4)
Vaccine & Fear CCT	0.330***	0.367***	0.354***	0.320***
	(0.031)	(0.026)	(0.034)	(0.028)
Observations	2467	2467	2465	2466
R-squared	0.126	0.143	0.143	0.107
Mean of Dependent Variable	0.292	0.242	0.280	0.289
Covariates	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X

Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). Missing observations are due to missing values. Control group is the group of women under Vaccine CCT and under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. All the dependent variables are dummy variables which take 1 if a respondent answers "very much" or "much" to the question "How did you feel about the flipchart you were just shown: Feel frightened, Feel tensed, Feel nervous and Feel uncomfortable" after the flipcharts intervention. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. Mean of Dependent Variable is mean under Vaccine CCT. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A1.5: Sub-group Analysis: Past Experience and Pregnancy

Sample:	Never received tetanus vaccine before	Never completed tetanus vaccine	Pregnant	Never received tetanus vaccine before	Never completed tetanus vaccine	Pregnant
Dependent variables:	Attended clinic			Received vaccine		
	(1)	(2)	(3)	(4)	(5)	(6)
Clinic CCT	-0.026	-0.010	0.001	-0.055***	-0.048	-0.056
	(0.019)	(0.040)	(0.048)	(0.020)	(0.046)	(0.057)
Vaccine CCT & Fear	-0.038*	0.021	-0.036	-0.039*	0.024	-0.025
	(0.020)	(0.040)	(0.041)	(0.020)	(0.040)	(0.042)
Observations	1493	611	446	1493	611	446
R-squared	0.132	0.097	0.123	0.128	0.111	0.111
Mean of Dependent Variable	0.778	0.685	0.755	0.778	0.685	0.755
Covariates	X	X	X	X	X	X
Fixed Effect by Village (80 villages`	X	X	X	X	X	X

Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). Control group is the group of women under Vaccine CCT and under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. Mean of Dependent Variable is mean under Vaccine CCT. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A1.6: Selection to Attend the Clinic among Non-Experienced

Sample:	Clinic CCT	Vaccine CCT	Difference
	(1)	(2)	(3)
Age	24.659	24.916	-0.257 (0.456)
Muslim	0.459	0.467	-0.008 (0.036)
Highest education = no education	0.461	0.479	-0.018 (0.036)
Has paid work	0.442	0.404	0.038 (0.035)
Monthly household earning per capita (naira	6298.6	6412.5	-113.9 (624.9)
Marital status = Single	0.216	0.191	0.025 (0.029)
Currently pregnant	0.170	0.176	-0.005 (0.028)
Have children	0.699	0.715	-0.016 (0.033)
Ever used clinic	0.648	0.67	-0.022 (0.034)
Distance to clinic (km)	1.664	1.621	0.043 (0.082)
Transport to clinic (naira)	129.04	131.29	-2.245 (14.72)
Opportunity costs to clinic (naira)	20.285	21.174	-0.888 (2.792)

Notes: Sample used here is 778 women who visited an assigned clinic and never received tetanus vaccination before under Clinic CCT or under Vaccine CCT. Standard errors in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A1.7: Sub-group Analysis: Did Messaging Change Perception of Tetanus?

Dependent variables:	Likely to contract tetanus	Number of people who die of tetanus	Very worried about Tetanus	Tetanus is very bad	Very important to be protected from tetanus	Vaccine efficacy	Heart rate
Panel A: Never Received Tetanus Vaccine Before	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Vaccine & Fear CCT	0.054*	4.364**	0.156***	0.156***	0.134***	0.892	4.521***
	(0.028)	(1.668)	(0.037)	(0.035)	(0.035)	(1.465)	(0.838)
Observations	1381	1378	1381	1381	1381	1380	1259
R-squared	0.095	0.101	0.115	0.108	0.108	0.087	0.373
Mean of Dependent Variable	0.448	36.533	0.486	0.568	0.664	28.975	88.235
Covariates	X	X	X	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X	X	X	X
Panel B: Never Completed Tetanus Vaccine	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Vaccine & Fear CCT	-0.011	-0.350	0.127**	0.144***	0.115***	-3.172	10.483***
	(0.039)	(1.869)	(0.053)	(0.036)	(0.038)	(2.948)	(1.439)
Observations	540	540	540	540	540	540	492
R-squared	0.240	0.158	0.233	0.096	0.117	0.212	0.530
Mean of Dependent Variable	0.523	44.704	0.704	0.782	0.847	44.051	88.245
Covariates	X	X	X	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X	X	X	X
Panel C: Pregnant	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Vaccine & Fear CCT	0.024	8.389***	0.026	0.035	-0.017	2.923	4.610***
	(0.070)	(3.024)	(0.070)	(0.052)	(0.055)	(3.628)	(1.550)
Observations	407	407	407	407	407	406	364
R-squared	0.114	0.134	0.198	0.199	0.198	0.147	0.417
Mean of Dependent Variable	0.462	38.769	0.636	0.720	0.804	31.331	91.216
Covariates	X	X	X	X	X	X	X
Fixed effect by village (80 villages)	X	X	X	X	X	X	X

Notes: Sample used here is the main sample of 2,490 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). Missing observations are due to missing or invalid values. Control group is the group of women under Vaccine CCT and under CCT=5. Robust standard errors clustered by villages (80 villages) are presented. All the dependent variables indicate the measurement after the flipcharts intervention. "Likely to get tetanus" is a binary variable which takes 1 if a respondent answers as " high likelihood" to the question "what is the likelihood that you get tetanus?" "Number of people who die of tetanus" is the number of people out of 100 a respondent provided to a question "Once they have tetanus, how many people do you think would die because of Tetanus?". "Very worried about tetanus" is a binary variable which takes 1 if a respondent answers "very worried" to the question "How worried are you that you might get tetanus? Very worried, worried, not too worried, not worried at all?". "Tetanus is very bad" is a binary variable which takes 1 is a respondent answers "very bad" to the question "How bad would it be if you get tetanus? Very bad, bad, not too bad, not bad at all?". "Very important to be protected from tetanus" is a binary variable which takes 1 is a respondent answers "very important" to the question "How important is it for you to make sure that you are protected from tetanus? Very important, important, not too important, not important at all?" "Vaccine efficacy" is the difference between hypothetical number of unvaccinated people whom each respondent thinks get tetanus and number of vaccinated people who get tetanus. "Heart rate" indicates the heart rate of a respondent measured. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic, and baseline attitudes such as likelihood of contracting tetanus, number of people the respondent thinks die out of tetanus, if the respondent is very worried about tetanus, if the respondent thinks tetanus is very bad, subjective vaccine efficacy and heart rate. Mean of Dependent Variable is mean under Vaccine CCT. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A1.8: Ex-Ante Characteristics by Past Tetanus Vaccine Experience

Sample:	Never received tetanus vaccine before	Received tetanus vaccine before	Difference
	(1)	(2)	(3)
Panel A: Demographics:			
Age	24.552	26.272	1.720***
Muslim	0.513	0.473	-0.040
Highest education = no education	0.480	0.487	0.007
Has Paid Work	0.398	0.504	0.106***
Monthly household earning per capita (naira)	6576.6	4781.8	-1794.8***
Marital status = Single	0.198	0.082	-0.116***
Currently pregnant	0.173	0.196	0.023
Have Children	0.675	0.905	0.230***
Ever used clinic	0.674	0.822	0.148***
Distance to Health Clinic	1.711	1.694	-0.017
Transport to clinic (naira)	131.310	116.397	-14.913
Opportunity costs to clinic (naira)	22.353	19.146	-3.207
Panel B: Attitudes toward Disease & Vaccine:			
Likely to get tetanus	0.333	0.445	0.112***
Likely to avoid tetanus	0.522	0.664	0.142***
Very worried about Tetanus	0.260	0.491	0.231***
Tetanus is very bad	0.372	0.534	0.162***
Very important to be protected from tetanus	0.413	0.612	0.199***
Vaccine efficacy	20.928	24.25	3.322***

Notes: Sample used here is 987 women with Vaccine CCT or Vaccine CCT & Fear who never received tetanus vaccine before in (1) and 673 of women with Vaccine CCT or Vaccine CCT & Fear who received tetanus vaccine before in (2). All the dependent variables are measured before the flipcharts intervention. "Likely to get tetanus" is a binary variable which takes 1 if a respondent answers as " high likelihood" to the question "What is the likelihood that you get tetanus?" "Very worried about tetanus" is a binary variable which takes 1 if a respondent answers "very worried" to the question "How worried are you that you might get tetanus? Very worried, worried, not too worried, not worried at all?" "Tetanus is very bad" is a binary variable which takes 1 is a respondent answers "very bad" to the question "How bad would it be if you get tetanus? Very bad, bad, not too bad, not bad at all?" "Very important to be protected from tetanus" is a binary variable which takes 1 is a respondent answers "very important" to the question "How important is it for you to make sure that you are protected from tetanus? Very important, important, not too important, not important at all?" "Vaccine efficacy" is the difference between hypothetical number of unvaccinated people who get tetanus and number of vaccinated people who get tetanus. * significant at 10%; ** significant at 5%; *** significant at 1%

Chapter 2

Learning from a Bitter Past? Behavioral Effect of Child's Death on Mothers

2.1 Introduction

Child mortality in sub-Saharan Africa is extremely high (WHO, 2014). Mothers' utilization of health services, such as antenatal care, delivery assistance and delivery at a health facility, is crucial for ensuring the health of children and mothers. However, the health facility utilization remains severely limited in most parts of sub-Saharan Africa. For example, 46 percent of pregnant women in sub-Saharan Africa do not sufficiently visit clinics for antenatal care (WHO, 2006), 52 percent of African women deliver at home instead of at a health facility, and 53 percent of deliveries take place in the absence of skilled health personnel (UNICEF, 2014). A number of past studies have attributed financial and informational constraints to the low utilization of health services in developing countries (Heller, 1982; Haddad and Fournier, 1995; Lindelow, 2002; Kasirye et al., 2004; Sharan et al., 2010; Lagarde et al., 2009; Kabakian-Khasholian and Campbell, 2007).

However, most past studies have ignored dynamic factors such as learning as a determinant of health service utilization. This paper examines the potential effect of personal salient experience on health behaviors. In particular, I examine the effect of a child's death on the mother's health behaviors for her subsequent children. Using Demographic and Health Surveys (DHS) from 26 African countries, I find that experiencing a child's death during its infancy makes mothers seek out health care for their subsequent children, specifically delivery assistance and delivery at some health facility.

The dynamic decision-making theory, which takes into account past experiences as a factor to affect the risk perception, predicts that the past pessimistic experience induces behavioral change (Cohen et al., 2008). Using the example of the demand for insurance, Cohen et al. (2008) find that among individuals who dot not buy insurance at the first period, they choose to buy insurance at the second period if they experience damages before the second period. Applying this model to my study, it predicts that among mothers who dot not use health services at the time of delivery for the first child, who experience the negative event of the first child's death are more likely to use the health services for the delivery of the second child.

Corno (2014) is one example that focused on the past experience as one of the factors influencing the current health seeking behavior. By using panel data in Tanzania, Corno found that agents sought medical care from the different type of health provider if the past treatments were ineffective. Corno's finding indicates behavior updates based on the past experience. Her paper, however, does not take into consideration the severity of the past experience. The past experience might be more likely to change one's subsequent behavior if this experience is salient to increase the perceived severity of the potential consequence of the current behavior. Thus, my study evaluates if the salience of the past experience induces the behavioral change by focusing on child's death.

The large sample of Demographic and Health Surveys (DHS) makes it possible to detect the causal relationship between child's death and subsequent health behaviors. This paper uses the data from 65,644 children from 46,780 women. Among the sample of my analysis, 10.1 percent of mothers experienced the first child's death, which is consistent with child mortality rates across sub-Saharan Africa. In order to see the causal relationship of the child's death on subsequent health behaviors, I create the panel data from DHS which is a cross-sectional data set. Because DHS contains detailed information on the pregnancy history and the delivery history of each respondent, I convert the data structure from each individual level to each pregnancy level which enables me to observe health behaviors and health outcomes among women over time.

The main analysis is based on simple difference estimators, comparing mothers whose first child died to mothers whose first child survived. I evaluate the impact of the death of the first child on mothers' health behaviors for the second child. Although the child's death is not randomly assigned, and thus the simple difference estimator faces an endogeneity problem, the potential bias due to this endogeneity seems to work against finding the positive effect of child's death on subsequent health behaviors. This is because child's death is negatively correlated with factors such as wealth and education level, but these factors are positively correlated with health service utilization. I also evaluate the change in health behaviors between the first and the second child among women whose first child died and compare it to the change among women whose first child survived (difference-in-differences estimators) to mitigate the endogeneity problem; the result is consistent with the simple difference estimators.

I find significant changes in mother's health seeking behaviors after the experience of the death of her first child. Mothers who experience the first child's death are 1.5 percentage points more likely to deliver the second child with assistance and they are 2.5 percentage points more likely to deliver the second child at a health facility than mothers who dot not experience the first child's death. This evidence supports the hypothesis that the salient negative experience influences the current health seeking behaviors. My finding is consistent with Corno's finding because both of the studies found that the past experience changed the subsequent behavior.

Because this study reveals that people change their behaviors if they receive salient negative information through their experience, one potential policy intervention is to emphasize and inform women of the negative effect of non-utilization of health facilities in a salient manner to induce the utilization of health facility. Future research should further explore this area as one possibility to improve health service use, and to decrease child mortality.

2.2 Data

The Demographic and Health Survey (DHS) data from 26 sub-Saharan African countries contains information on mothers' delivery records for the past five years from the year when the survey was conducted. For each birth which occurred during the reference period, mothers were asked if the child is alive, about the timing of the child's death if the child died, who assisted the delivery[1] and the place where the delivery took place[2].

Because the delivery records from this data set only captured the most recent births within the past 5 years from the survey year, the data did not include all the delivery history but it exclusively focused on younger women

[1]The list of the people who assisted the delivery is health personnel (doctor, nurse/midwife/auxiliary midwife), other person (traditional birth attendant, relative/friend, other), or no one.

[2]The list of the place where the delivery took place is your home, other home, public sector (government hospital, government health post, other public), private sector (private hospital/clinic, other private), or other.

at their reproductive age. Although this limitation reduces the sample size, it has an analytical advantage. The data does not suffer from severe recall bias as this analysis solely focuses on recent births. Focusing only on the recent births also mitigates any changes in their environments and in their behaviors such as new constructions of health facilities and shifts in their cultural values towards western technologies. Mitigating such changes is important because these changes could promote the health facility utilization independent of the experience of child's death.

I also restrict the sample to those who gave birth to the first child between 2000 and 2010 and I refer to this set of data as the total sample. The main analysis uses the further restricted sample which includes only the first and the second child; that is, I examine the relationship between women's experience of the first child's death and health service utilizations for the second child. By focusing only on the first and the second child, this analysis mitigates the reproduction selection because most women deliver at least two children. The total sample consists of 65,644 children from 46,780 women. Out of these observations, my main analysis focuses on 16,390 women who at least have two children.

Two main dependent variables used in this study are whether a mother seeks any human assistance at delivery and whether a mother delivers at any health facility. Human assistance includes health personnel such as doctors, nurses, and midwife and other persons such as traditional birth attendants, relatives and friends. Health facilities include hospitals, health centers, and health clinics. Although the data also contains a variety of useful information on health behaviors other than the ones related to delivery such as antenatal care and postnatal care visits, they are not used in the analysis because of the data structure. Women were asked about antenatal care and postnatal care only for the last birth and as a result I cannot construct the panel structure for these behaviors. In addition to information on mortality and delivery of the child, surveys contain data on mother's demographic and economic characteristics such as age and education as well as household characteristics such as wealth level.

Table 2.1 shows the summary statistics of women and their households when they have the second child, as well as the summary statistics of women's second children. On average, women are 23 years old. They have very low level of education: 42.5 percent of women did not receive any education and 35.1 percent of women completed only primary school. 37.4 percent of the women are Muslim. The number of children born is 2.1, which is much smaller than the African average fertility rate (around 5). This is because the analysis focuses on younger women who had the first child after 2000. Fifty-seven percent of women had delivered the first child in the previous year of second child's birth. The percentage of women who experienced child's death at least once is 22.3 percent while 16.7 percent of women experienced the first child's death. The percentage of the first child's death is high mainly because the duration between the birth date of the first child and the survey date tends to be longer than for other children.

Table 2.1 (Panel B) shows the household characteristics. The majority of women (70.6 percent) live in rural areas and 43 percent of their households are poor in terms of wealth level. Table 2.1 (Panel C) shows the characteristics of the second children. Around half of the second children are female, and eight percent of the children are not alive. On average, women perceived that the children were born with average size.

In order to analyze differences in characteristics by experience of child's death, the sample is disaggregated. Table 2.1 (column 2 and 3) corresponds to summary statistics respectively for women who lost their first child and for women who did not. The health status of the first child (dead or alive) is correlated with indicators of economic and health condition. Women who lost their first child are almost 1 year younger. They are 9.9 percentage points more likely to have obtained no education. They are 8.7 percentage points more likely to be Muslim. The number of children born is higher than others by 0.09. One possible mechanism for the larger number of children is that after the death of the child, mothers try to compensate for the loss by engaging in more reproduction. Furthermore, women who experienced the death of the first child are 0.71 years younger at their first pregnancy than those who did not experience the death.

Child's death is correlated with health behaviors as well as health and economic outcomes. First of all, mothers in rural areas with poor households are more likely to experience child's death (Table 2.1 Panel B). Compared to children of mothers whose first child is alive, the children of mothers with experience of the first child's death are 9 percentage points less likely to be alive. The size of the second child at birth is smaller among mothers who lost their first child, although the difference is insignificant (Table 2.1 Panel C).

2.3 Framework

Cohen et al. (2008) constructed a model based on dynamic decision-making theory which takes into account past experiences as a factor to affect the risk perception. Using the example of the demand for insurance, their model suggests that the past negative experience induces behavioral change. Specifically, Cohen et al. (2008) find that among individuals who did not buy insurance at the first period, they choose to buy insurance at the second period if they experienced damages before the second period. Cohen's model directly applies to my study: the model predicts that among mothers who did not use health services at the time of delivery for the first child, those who experienced the pessimistic event, the first child's death, are more likely to use the health services for the delivery of the second child.

Health Belief Model (Rosenstock, 1966) is the psychological model which predicts health behaviors based on one's perception. Past experiences influence subsequent health behaviors by affecting the perceived likelihood and the perceived severity of a consequence of the past health behavior. Mothers who have experienced their child's death might perceive the general or personal risks of infant mortality at the time of delivery. The realization of a child's death increases the perceived likelihood of the same outcome in the subsequent delivery, and thus it could increase the health facility utilization after child's death. The realization of a child's death could also increase the perceived severity of the consequence of child delivery, which might again promote the health behaviors.

At the same time, it is also possible that the experience of a child's death dis-incentivizes mothers from utilizing the health facility due to psychological reasons. Psychological traumatic incidences may make women avoid a place which reminds them of the trauma (Dempsey et al., 2000). For example, if a mother delivers at a health facility and her child dies, the mother may not want to try the same health facility for the next child but delivers at home. The same mechanism may increase the take-up of health services if the child's death occurs at home. Thus even if women seek health service after they experience the child's death, this might not always be attributed to the awareness of the importance in health facility utilization but they might only switch their behaviors due to psychological factors. In the analysis, I try to differentiate these two different mechanisms: learning the importance of utilizing health facilities and mere switching behavior due to psychological factors.

2.4 Results

My study estimates the effect of experiencing the child's death on the utilization of delivery assistance and of the health facility at the time of delivery for the subsequent child. The main analysis restricts the sample to the first and the second child. I first evaluate the effect of child's death using difference-in-differences estimators by comparing women's health behaviors with and without experiences of the first child's death for the first and second child. I then move to the analysis using the simple difference estimator by comparing the utilization of health services at the time of the delivery of the second child for women with and without the first child's death. Results consistently show that the first child's death has significant effects both on the utilization of delivery assistance and of health facilities at the time of delivery for the second child.

2.4.1 Difference-in-Differences

Table 2.2 (Panel A and B) presents the difference-in-differences analysis. The change in the health behavior of mothers from the time of the first child's delivery to that for the second child is compared among mothers who lost their first child and mothers who did not. Main variables are the utilization of delivery assistance and the utilization of health facilities at the time of delivery. Panel A shows that 95.6 percent of mothers whose first child eventually died utilized delivery assistance for the first child, while 97.4 percent of mothers whose first child survived utilized the assistance. For the second child, both mothers, regardless of the status of the first child, reduced the utilization of delivery assistance. However, mothers who lost their first child had a smaller reduction in the probability of delivery assistance between the first and the second delivery by 1.2 percentage points. This 1.2 percentage points is the difference-in-differences estimator of the effect of the first child's death on delivery assistance.

Panel B shows the similar analysis for the delivery place. Although both mothers, those who lost their first child and those who did not, reduced the likelihood of the delivery at health facilities for the second child, mothers who lost their first child had a smaller reduction in the probability of delivery at health facilities between the first and the second delivery by 5.1 percentage points[3].

This trend remains robust when the sample is restricted only to those who delivered the first child without utilizing the health facility (Table 2.2, Panel C and D). Among women who did not deliver the first child with any assistance, the first child's death increased the probability of seeking delivery assistance for the second child by 11.6 percentage points. Similarly, the first child's death increased the probability of delivering the second child at a health facility by 3.9 percentage points among mothers did not deliver the first child at a health facility.

I now examine the effect of the first child's death on the health seeking behavior in a difference-in-differences regression framework. The reason of using the regression framework is that I can include covariates which are potentially correlated with the independent variable, the child's death. To examine the effect of the first child's death on the health seeking behavior in a difference-in-differences regression framework, I estimate

[3]This analysis is valid under the assumption that the difference of the health behavior for the first child between mothers whose first child died and mothers whose first child survived (the benchmark) reflect the correlation between background characteristics, such as the levels of education and wealth, and child's death. However, this benchmark is not useful if the health behaviors for the first child among mothers is causing the first child's death.

$$Y_{ij} = \alpha + \beta_1 1stChildDied_{ij} + \beta_2 2ndChild_{ij} + \beta_3(1stChildDied \times 2ndChild_{ij}) + X_{ij}'\mu + \epsilon_{ij} \quad (2.1)$$

The sample is women who delivered at least two children. Utilization of health services for the first or the second child is indicated by Y_{ij}=1 for a mother i in a locality j. $1stChildDied$ indicates if a mother's first child died and $2ndChild$ is the dummy for the second child. The hypothesis is that women utilize the health service more for the second child after they experience their first child's death than women whose first child did not die, given all the other variables constant. X is a vector of controls including age, age squared, Muslim dummy, rural dummy, wealth index dummy, education level, and country dummies.

Table 2.3 (column 1) replicates the result from Table 2.2 (Panel A); for the second child, mothers are 1.2 percentage points more likely to have delivery assistance if the first child died than if the first child survived. Column 2 shows the robust result after including covariates and district-level fixed effects that the first child's death increased the likelihood of delivery assistance for the second child. This indicates that covariates have low correlation with the child's death which could bias the estimator. Similarly, Column 3 and 4 show the regression result for the delivery place. Column 3 replicates the result from Table 2.2 (Panel B); mothers are 5.1 percentage points more likely to deliver at health facilities for the second child if the first child died than when the first child survived. Column 4 shows the consistent result even after covariates and fixed effects are included in the regression. The effect of the first child's death on the delivery at health facilities is 3.9 percentage points. The effect gets smaller once covariates are included from 5.1 to 3.9 percentage points because of the correlation between the child's death and other covariates.

2.4.2 Simple Difference

A more straightforward way to examine changes in health behaviors after the child's death is to use the simple difference estimator. I compare the utilization of delivery assistance and of health facilities at the time of delivery for the second child among women with and without the experience of the first child's death, given the past health behaviors as well as background characteristics constant. To examine the effect of first child's death on the health seeking behavior for the second child in a simple-difference regression framework, I estimate

$$Y_{ij} = \alpha + \beta_1 Death_{ij} + X_{ij}{}'\mu + \epsilon_{ij} \tag{2.2}$$

Utilization of the health service for the second child is indicated by Y_{ij}=1 for a mother i in a locality j. *Death* indicates if a mother's first child died. I hypothesize that those who experience the first child's death utilize the health service more for the second child than women whose first child is alive, given all the other variables constant. X is a vector of controls included in (2.1) as well as variables which indicate the health service utilization for the first child. The variable of the past health behavior for the first child has a role to capture a trend of mother's health behavior while the death experience can measure deviation from the trend.

The child's death is negatively correlated with both delivery assistance and delivery at a health facility if past health behaviors are not taken into consideration. The likelihood of child's death is 2.2 to 3.0 percentage points higher if mothers do not deliver with any assistance, and it is 1.7 to 2.0 percentage points higher if mothers do not deliver at a health facility (Table 2.4). Table 2.4 also shows that women with poor economic backgrounds are more likely to experience their child's death (Table 2.4 column 1 and 2) and at the same time, they are less likely to use health facilities (Table 2.4 column

3 to 6). Thus it is necessary to capture their past behavior as a trend and to factor out the deviation which is captured by the child's death.

Table 2.5 (Panel A) shows the effect of the first child's death on delivery assistance for the second child. First, column 1 shows that without controlling for covariates, the child's death is negatively correlated with delivery assistance. This is because of the correlation between covariates and child's death as shown in Table 2.4. Table 2.5 (column 2) includes delivery assistance for the first child as one of controls and I find that the null effect of the child's death, and there is a strong correlation between the assistance at the first child and that for the second child. Once I control for various covariates and include district-level fixed effects, experiencing the first child's death increases the probability of seeking delivery assistance for the second child by 1.5 percentage points. Although the effect of a child's death on delivery assistance is considerably small, this is because a very high proportion of mothers (94.5 percent) already received delivery assistance for the first child.

Table 2.5 (column 4 and 5) restricts the sample to mothers who delivered the first child without any assistance. Without controls, the first child's death increased the probability of seeking assistance for the next child by 11.6 percentage points (column 4), while the effect of the child's death reduced to 6.9 percentage points with controls. The effect of the child's death is strong among women who did not use delivery assistance for the first child.

Table 2.5 (Panel B) shows the effect of the first child's death on the delivery place for the second child. Column 6 shows that the child's death is strongly negatively correlated with the delivery at a health facility without any covariates. But it is important to include the past health behaviors in the regression. Once the dummy variable to indicate if a mother delivered a first child at a health facility is included, the first child's death has a positive effect on the delivery at health facilities for the second child (column 7). With covariates and fixed effects, experiencing the first child's death increases the probability of second child delivery at some facility by 2.5 percentage points (column 8).

Among those who delivered the first child at home, the first child's death increased the probability of delivery at a health facility for the second child by 3.9 percent percentage points (Table 2.5, column 9), although the effect of the child's death gets weaker(1.6 percentage points) and insignificant with controls and fixed effects (column 10)[4].

The timing of the child's death could be an important variation to induce the behavioral change. For example, if a child dies around the delivery, the mother may attribute the cause of the child's death more to the environment at the delivery than the case in which the child dies at a later time. Table 2.6 shows the differential effect of the death by the timing of the death. Early death occurrences weakly promote more of delivery assistance than the later death (Table 2.6 column 1 and 2), but it is only suggestive because of the power[5]. Among those who delivered the first child without any assistance, the first child's death within one month increases the likelihood of seeking delivery assistance for the second child by 19.3 percentage points while the child's death later than 1 month mostly has less impact on delivery assistance for the second child (column 3). However, the effect disappears once covariates and fixed effects are included (column 4).

On the other hand, early death occurrences have a stronger and more positive effect on the subsequent delivery at a health facility than the later death. Death of the first child within one month increases the probability of delivering at a health facility for the second child by 4.1 percentage points,

[4]The effect of the first child's death on health behaviors among those who did not utilize health facilities for the first child becomes insignificant once the district-level fixed effect is included. This might be due to the limited observation within the district, or the district is not the correct unit for the fixed-effect analysis.

[5]Note that the rate of delivery assistance was already very high. for the first child

while the first child's death which occurred later than 1 month did not have any significant effect on the delivery place for the second child (Table 2.6 column 5 and 6). This is evidence that the child's death influences one's behaviors around delivery if she links the child's death more with child delivery such as complications at birth. Table 2.6 (column 7) shows the consistent result that the child's death right after birth changes the health behaviors around delivery; the child's death within 1 month increases the likelihood of the delivery at health facilities by 8.2 percentage points among women who delivered the first child at home, although the inclusion of covariates and fixed effects cancels out the effect (column 8). Overall, this result adds to the evidence that mothers change their behavior around delivery because the child's death signals the need for the behavioral change around delivery.

Although results have shown that the child's death drives mother's health behaviors, this behavioral change can be attributed not to learning but simply to switching. Because child's death is a significant negative shock on mothers, they might only switch their behaviors due to psychological factors such as trauma, not because they learn the importance of health service utilization. However, Table 2.7 confirms that the behavioral change is not driven by switching. If switching occurs, those who delivered the first child with assistance or at a health facility, and who lost the first child, can be more likely to deliver the second child without the assistance and at home. However, I do not find this result. Among women who delivered the first child with assistance, the first child's death did not increase the likelihood that they delivered the second child without any assistance. Similarly, among women who delivered the first child at a health facility, the first child's death did not increase the likelihood that they delivered the second child at home. This result is suggestive evidence that women actually learn the importance of utilizing health service from the salient experience of their child's death.

So far, the analysis has been limited to the first and second child but it could be extended to all the children born on or after 2000. To examine the effect of the child's death in the past on the health seeking behavior for the subsequent child in a regression framework, I estimate

$$Y_{ijk} = \alpha + \beta_1 Death_{ij(k-1)} + X_{ijk}'\mu + \epsilon_{ijk} \tag{2.3}$$

Utilization of health services for the k-th child is indicated by Y_{ijk}=1 for a mother i in a locality j. $Death_{ij(k-1)}$ indicates if a mother's $(k-1)$-th child died. In order to capture the characteristics specific to each birth, the vector of controls X includes the birth-order dummies in addition to all the variables included in the regression specification (2).

The results under the specification (3) are consistent with the main result which examines the effect of first child's death on health behaviors for the second child. A previous child's death increases the probability of seeking delivery assistance for the subsequent child by 1.0 percentage points, and it increases the probability of delivering the subsequent child at a health facility by 2.4 percentage points (Table 2.8). Furthermore, I find the consistent result that the child's death induces the subsequent health behaviors even when I restrict the sample to mothers who lost at least one child at some point (Table 2.8 column 3 and 6).

Overall, African mothers learn from a bitter salient past, a child's death, to update their health seeking behaviors. The child's death is a driving force for mothers to seek delivery assistance and to deliver at some health facility for the subsequent child.

2.5 Consideration for Identification Strategy

Here I discuss the potential econometric problems which can threaten the validity of regression model as introduced in (2). Although the concern of reverse causality is mitigated by restricting the sample to the first child's death and health service use for the second child, examining the model specifications with using the simple OLS could still cause biased estimators because the experience of the child's death is not randomly assigned. Unobservable factors can affect mothers' experience of their child's death.

However, biases induced by the non-randomness seem to work against the hypothesis. As presented in Table 2.4, the use of health services is an important determinant of a child's survival. Other demographic and economic factors also explain the child's health outcome. Lower education attainment and poorer wealth level significantly increases the probability of the child's death while they are correlated with lower health service utilization (Table 2.4 column 3 to 6). It implies that mothers who lost the first child have characteristics which are negatively correlated with the likelihood of health service utilization. Thus finding positive correlation between the first child's death and the health service use for the second child is not induced by biases as far as they work against finding the result.

Unobservable genetic factors should also be correlated with the child's death. If a mother uses a health facility more because of her genetic problem which increases the probability of her child's death, then it induces the upward bias in the specification (2). However, this bias should be mitigated by one of the control variables, health service use for the first child. If she learns her genetic problem through the experience of her child's death to change the health seeking behavior for the subsequent child, this is exactly what this analysis is trying to observe. Furthermore, I also analyze the effect of child's death on subsequent health behaviors only among those who lost at least one child at some point (Table 2.8) and find that mothers change behaviors after the child's death.

Another important concern is the reproduction decision for the second child. Because the main sample is restricted to women who have at least two children within 5 years from the survey year, there is a possibility of the sample selection. Two factors could affect this selection. One is the genetics of the woman and another is the preference for sexual activities or intensive reproduction. Specification (1) and (2) eliminates women who are genetically less capable of reproduction and it is possible that this genetic reproductive ability motivates women to seek assistance at a health facility more than others. Similarly, the sample only includes those who have the stronger preference for the sexual behavior or the intensive reproduction within a fixed period. This preference can affect the health behavior at delivery in either way; if they know about their preference and that it can risk their infant at delivery, they might care to seek assistance more than others. If, on the other hand, they are risky both in the reproduction behavior as well as in general health behaviors, they might not care for delivery assistance as much as others do. However, I claim that the selection bias does not cause a serious problem because the average birth interval in Africa is 2.28 years (DHS) thus the average woman has two or more children within 5 years. My data is not restrictive to a specific sample, but deals with the average population.

Table 2.1 shows that if the first child survived, they were less likely to have more children than when the first child died. This indicates another possible selection to have the second child by the first child's status. Among women whose first child survived, if the decision to have additional child is negatively correlated with health behaviors around delivery, this selection might have caused the upward bias for the main result.

The last concern is the change in the access to health facilities over time. For example, if the government decides to construct health facilities intensively in areas with worse health outcomes, people in such areas might improve their health behaviors simply because they benefit from the better access to health services over time. Because DHS does not have information on the access to health facilities, I control for this factor by including district-level fixed effects in the regression analysis. The result, that child's death improved the subsequent health behaviors, has been consistent with or without fixed effects. However, it should be noted that this study cannot address changes in access to health facilities if such changes occur in geographical units which are smaller than the district.

2.6 Conclusion

This paper examines whether the salient and negative experiences result in the change in health behaviors. Specifically I analyze the effect of a child's death on the utilization of health services at the next child's delivery. These health services include delivery assistance and delivery at a health facility. Although the child's death does not randomly occur, the simple OLS method is used because potential biases seem to work against finding the result. I find significant changes in health seeking behavior after the experience of a child's death. Mothers who experienced the first child's death are 1.5 percentage point more likely to deliver with some assistance and 2.5 percentage points more likely to deliver the second child at some health facility than mothers who did not experience the first child's death. This evidence supports the claim that past negative experience affects the current health seeking behavior if the experience is severe.

An important policy implication emerges from this study. Because this study reveals that people change their behaviors if they receive salient negative information through their experience, policy makers could focus on intervention programs which emphasize and inform mothers about negative consequences of non-utilization of facilities to increase the use of health facilities. For example, in order to increase the immunization rate in African countries, information emphasizing the negative consequence of non-vaccination such as severe disease symptoms might increase the vaccination take-up by influencing the perceived risk and severity of the disease. Thus an obvious question remaining for future research is whether negative information is the important factor for behavioral change and whether the negative information can be transmitted not only through personal experience but also through other people's experiences.

References

Abdulraheem, S., Onajole, T., Jimoh, G., and Oladipo, R. (2011). Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *Journal of Public Health and Epidemiology*, 3(4).

Abhyankar, P., O'Connor, B., and Lawton, R. (2008). The role of message framing in promoting MMR-vaccination: Evidence of a loss-frame advantage. *Psychology, Health and Medicine*, 13(1).

Adelekan, M. and Lawal, R. (2006). Drug use and HIV infection in Nigeria: A review of recent findings. *African Journal of Drug and Alcohol Studies*, 5(2).

Banerjee, A., Duflo, E., Glennerster, R., and Kothari, D. (2010). Improving immunization coverage in rural India: A clustered randomized controlled evaluation of immunization campaigns with and without incentives. *British Medical Journal*, 340(c2220).

Barham, T. and Maluccio, J. (2009). Eradicating disease: The effect of Conditional Cash Transfers on vaccination coverage in rural Nicaragua. *Journal of Health Economics*, 28(3).

Blencowe, H., Lawn, J., Vandelaer, J., Roper, M., and Cousens, S. (2010). Tetanus toxoid immunization to reduce mortality from neonatal tetanus. *International Journal of Epidemiology*, 39.

Bloom, D., Canning, D., and Weston, M. (2005). The value of vaccination. *World Economics*, 6(3).

Brenzel, L., Wolfson, J., Fox-Rushby, J., Miller, M., and Halsey, A. (2006). Vaccine-preventable diseases. *World Bank*, 20.

Buor, D. (2003). Analysing the primacy of distance in the utilization of health services in the Ahafo-Ano South district, Ghana. *International Journal of Health Planning and Management*, 18(4).

Caplin, A. (2003). Fear as a policy instrument: Economic and psychological perspectives on intertemporal choice. *Russell Sage Foundation*.

Chaudhury, N., Hammer, J., Kremer, M., Muralidharan, K., and Rogers, F. (2004). Teacher and health care provider absenteeism: A multi-country study. *World Bank*.

Commission, N. P. and Macro, I. (2009). Nigeria demographic and health survey 2008. *National Population Commission and ICF Macro*.

Currie, J. (2006). The take-up of social benefits. *Russell Sage*.

Deacon, D. and Abramowitz, J. (2006). Fear of needles and vasovagal reactions among phlebotomy patient. *Journal of Anxiety Disorders*, 20(7).

Dillard, P. and Anderson, W. (2004). The role of fear in persuasion. *Psychology and Marketing*, 21(11).

Dupas, P. (2011a). Do teenagers respond to hiv risk information? evidence from a field experiment in Kenya. *American Economic Journal: Applied Economics*, 1.

Dupas, P. (2011b). Health behavior in developing countries. *Annual Review of Economics*, 3.

Ehreth, J. (2003). The global value of vaccination. *Vaccine*, 21.

Essen, G. V., Kuyvenhoven, M., and R. De Melker, R. (1997). Why do healthy elderly people fail to comply with influenza vaccination? *Age and Ageing*, 26.

Fritsche, G., Soeters, R., and Meessen, B. (2014). Performance-based financing toolkit. *World Bank*.

Gauri, V. and Khaleghian, P. (2002). Immunization in developing countries its political and organizational determinants. *The World Bank Development Research Group Policy Research Working Paper*, (2769).

Gerend, M. and Shepherd, J. (2007). Using message framing to promote acceptance of the human papillomavirus vaccine. *Health Psychology*, 26(6).

Gertler, J. (2004). Do conditional cash transfers improve child health? evidence from PROGRESA control randomized experiment. *American Economic Review*, 94.

Goldberg, A. (2014). Immunization decisions in rural northern nigeria. *Dissertation at Columbia University*.

Goldstein, M., Zivin, G., Pop-Eleches, J. H. C., and Thirumurthy, H. (2013). The effect of absenteeism and clinic protocol on health outcomes: The case of mother-to-child transmission of HIV in Kenya. *American Economic Journal: Applied Economics*, 5(2).

Grossman, M. (2000). The human capital model. *Handbook of health economics*.

Harris, C. (2010). Feelings of dread and intertemporal choice. *Journal of Behavioral Decision Making*, 25(1).

IRIN (2013). Analysis roots of polio vaccine (april 4, 2013). roots of polio vaccine suspicion. *IRIN News*.

Jepson, C. and Chaiken, S. (1990). Chronic issue-specific fear inhibits systematic processing of persuasive communications. *Journal of Social Behavior and Personality*, 5.

Jheeta, M. and Newell, J. (2008). Childhood vaccination in Africa and Asia: the effects of parents' knowledge and attitudes. *Bulletin of the World Health Organization*, 86(6).

Job, S. (1988). Effective and ineffective use of fear in health promotion campaigns. *American Journal of Public Health*, 78(2).

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica*, 47.

Kaufmann, J. and Feldbaum, H. (2009). Diplomacy and the polio immunization boycott in northern Nigeria. *Health Affairs*, 28(4).

Kimmel, S., Burns, T., and Zimmerman, R. (2007). Addressing immunization barriers, benefits, and risks. *Journal of Family Practice*, 56(3).

Kreuter, M. and Strecher, V. (1995). Changing inaccurate perceptions of health risk: Results from a randomized trial. *Health Psychology*, 14(1).

Lagarde, M., Haines, A., and Palmer, N. (2009). The impact of conditional cash transfers on health outcomes and use of health services in low and middle income countries. *Cochrane Database of Systematic*, 4(CD008137).

Meessen, B., Soucat, A., and Sekabaraga, C. (2011). Performance-based financing: just a donor fad or a catalyst towards comprehensive health-care reform? *Bulletin of the World Health Organization*, 89.

Middaugh, P. (1979). Side effects of diphtheria-tetanus toxoid in adults. *American Journal of Public Health*, 69.

Moran, W., Nelson, K., Wofford, J., Ramon, V., and Case, D. (1996). Increasing influenza immunization among high-risk patients: Education or financial incentive? *American Journal of Medicine*, 101(6).

Morris, S., Flores, R., Olinto, P., and Medina, J. (2004). Monetary incentives in primary health care and effects on use and coverage of preventive health care interventions in rural honduras: cluster randomised trial. *Lancet*, 9450(4).

Myerson, J. and Green, L. (1995). Discounting of delayed rewards. *Journal of the Experimental Analysis of Behavior*, 64.

Nichter, M. (1995). Vaccinations in the third world: A consideration of community demand. *Social Science and Medicine*, 41(5).

Nyhan, B., Reifler, J., and Richey, S. (2014). Effective messages in vaccine promotion: a randomized trial. *Pediatrics*, 133(4).

Ogunlesi, A. (2011). Vaccines for women to prevent neonatal tetanus: Rhl commentary. *The WHO Reproductive Health Library.*

O'Keefe, D. and Nan, X. (2012). The relative persuasiveness of gain- and loss-framed messages for promoting vaccination: A meta-analytic review. *Health Communication*, 27(8).

Okwaraji, B., Cousens, S., Berhane, Y., Mulholland, K., and Edmond, K. (2012). Effect of geographical access to health facilities on child mortality in rural Ethiopia: A community based cross sectional study. *PLoS ONE*, 7(3).

Onalo, R., Ishiaku, H., and Ogala, W. (2010). Prevalence and outcome of neonatal tetanus in Zaria, northwestern Nigeria. *Journal of Infect Dev Ctries*, 26(5).

Orimadegun, A., Adedayo, A., and Olusegun, A. (2014). Adolescent girls' understanding of tetanus infection and prevention: Implications for the disease control in western Nigeria. *Frontiers in Public Health*, 2.

Oruamabo, S. (2007). Neonatal tetanus in Nigeria: does it still pose a major threat to neonatal survival? *Archives of Disease in Childhood*, 92.

Pebley, A., Goldman, N., and Rodriguez, G. (1996). Prenatal and delivery care and childhood immunization in Guatemala: Do family and community matter? *Demography*, 33(2).

Petrosino, A., Turpin-Petrosino, C., Hollis-Peel, M., J., L., and Stern, A. (2004). Scared straight and other juvenile awareness programs for preventing juvenile delinquency. *J Crime Prevention Research Revie.*

Rachiotis, G., Mouchtouri, A., Kremastinou, J., Gourgoulianis, K., and Hadjichristodoulou, C. (2010). Low acceptance of vaccination against the 2009 pandemic influenza a(h1n1) among healthcare workers in Greece. *Euro Surveill*, 15(6).

Rachlin, H., Rainieri, A., and Cross, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behavior*, 55.

Rainey, J., Watkins, M., Ryman, T., Sandhu, P., Bo, A., and Banerjee, K. (2011). Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: findings from a systematic review of the published literature, 1999-2009. *Vaccine*, 29(46).

Renne, E. (2006). Perspectives on polio and immunization in northern Nigeria. *Social Science and Medicine*, 63(7).

Robertson, L., Mushati, P., Eaton, W., Dumba, L., Mavise, G., Makoni, J., Schumache, C., Crea, T., Monasch, R., Sherr, L., Garnett, P., Nyamukapa, C., and Gregson, S. (2013). Effects of unconditional and conditional cash transfers on child health and development in Zimbabwe: a cluster-randomised trial. *Lancet,*, 381(9874).

Rothman, A. and Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychological Bulletin*, 121.

Rothman, A., Salovey, P., Antone, C., Keough, K., and Martin, C. (1993). The influence of message framing on intentions to perform health behaviors. *Journal of Experimental Social Psychology*, 29.

Salinas-Rodriguez, A. and Manrique-Espinoza, B. (2013). Effect of the conditional cash transfer program oportunidades on vaccination coverage in older Mexican people. *BMC International health and human rights*, 13(1).

Steele, F., Diamond, I., and Amin, S. (1996). Immunization uptake in rural Bangladesh: a Multilevel analysis. *Journal of the Royal Statistical Society*, A(159).

Sutherland, K., Leatherman, S., and Christianson, J. (2008). Paying the patient: does it work? A revew of patient-targeted incentives. *The Health Foundation*.

Thysen, S., Byberg, S., Pedersen, M., Rodrigues, A., Ravn, H., Martins, C., Benn, C., Aaby, P., and Fisker, A. (2014). BCG coverage and barriers to

BCG vaccination in Guinea-Bissau: an observational study. *BMC Public Health*, 14(1).

Tumusiime, P., Gonani, A., Walker, O., Asbu, E., Awases, M., and Kariyo, P. (2012). Health systems in sub-saharan africa: What is their status and role in meeting the health millennium development goals? *The African Health Monitor*.

Umar, N., Hajara, M., and Khalifa, M. (2011). Reduction of client waiting time using task shifting in an anti-retroviral clinic at Specialist Hospital Bauchi, Nigeria. *Journal of Public Health in Africa*, 2(e2).

UNICEF (2001). Combatting antivaccination rumors: Lessons learned from case studies in east africa. *UNICEF*.

UNICEF (2010). Maternal and neonatal tetanus elimination initiative. *UNICEF*.

Weaver, T., Metrebia, N., Hellier, J., Pilling, S., Charles, V., Little, N., Poovendran, D., Mitcheson, L., Ryan, F., Bowden-Jones, O., Dunn, J., Glaspe, A., Finch, E., and Strang, J. (2014). Use of contingency management incentives to improve completion of hepatitis B vaccination in people undergoing treatment for heroin dependence: a cluster randomised trial. *Lancet*, 38(9938).

WHO (2006). Maternal immunization against tetanus. *WHO Standards for Maternal and Neonatal Care*.

WHO (2013). Weekly epidemiological record. *WHO*, 88.

WHO (2014). Weekly epidemiological record. *WHO*, 89.

Witte, K. (1994). Fear control and danger control: A test of the extended parallel process model. *Communication Monographs*, 61(2).

Witte, K. and Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education and Behavior*, 27(5).

Zwane, A. and Kremer, M. (2007). What works in fighting diarrheal diseases in developing countries? a critical review. *World Bank Research Observer*, 22(1).

Zziwa, G. (2009). Review of tetanus admissions to a rural Ugandan hospital. *Health Policy and Development*, 7(3).

Table 2.1: Summary Statistics: Woman, Household, and Second Child

Sample:	Total (N=13593)	First Child: Died (N=2263)	First Child: Did Not Die (N=11330)	Difference
	(1)	(2)	(3)	(4)
Panel A: Woman's characteristics				
Age	23.191	22.429	23.347	-0.918***
Highest education= None	0.425	0.508	0.409	0.099***
Highest education= Primary	0.351	0.335	0.354	-0.019*
Highest education= Secondary	0.197	0.146	0.207	-0.061***
Highest education= Tertiary or more	0.027	0.010	0.030	-0.020***
Muslim	0.374	0.447	0.360	0.087***
Total children ever born	2.140	2.212	2.124	0.088***
Births in past year	0.573	0.540	0.578	-0.038**
Children ever died	0.223	1.000	0.067	0.933***
Number of children dead	1.143	1.176	1.040	0.136***
First child died	0.167	1.000	0.000	1.000***
Age at the first pregnancy	19.600	19.012	19.723	-0.711***
Panel B: Household characteristics				
Rural	0.706	0.771	0.692	0.079***
Wealth index = Poorest	0.224	0.241	0.218	0.023**
Wealth index = Poorer	0.209	0.250	0.200	0.050***
Wealth index = Middle	0.203	0.200	0.203	-0.003
Wealth index = Richer	0.183	0.178	0.185	-0.007
Wealth index = Richest	0.183	0.131	0.193	-0.062***
Panel C: Second child's characteristics				
Female	0.490	0.494	0.490	0.004
Alive	0.923	0.848	0.938	-0.090***
Size of baby at birth	3.228	3.219	3.232	-0.013

Notes: The Sample is restricted to women who have at least 2 children and gave birth to the first child between the year of 2000 and 2010. Number of children dead is conditioned on ever died. Size of baby at birth: 1=very small, 2=smaller than average, 3=average, 4=larger than average, 5=very large. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.2: Difference-in-Differences Estimator of Child's Death

Panel A: Delivery Assistance

	Delivery assistance for first child	Delivery assistance for second child	Difference
First child died	0.956(N=4596)	0.945(N=2757)	-0.010**
First child did not die	0.974(N=41899)	0.951(N=13817)	-0.023***
Difference	-0.018***	-0.006	0.012***

Panel B: Delivery Place

	Delivery at health facility for first child	Delivery at health facility for second child	Difference
First child died	0.530(N=4583)	0.475(N=2756)	-0.054***
First child did not die	0.634(N=41826)	0.528(N=13794)	-0.106***
Difference	-0.105***	-0.053***	0.051***

Panel C: Second Delivery Assitance Among Women with First Delivery without Assistance

	Delivery assistance for second child
First child died	0.298(N=131)
First child did not die	0.182(N=478)
Difference	0.116**

Panel D: Second Delivery Place Among Women with First Delivery at Home

	Delivery at health facility for second child
First child died	0.175(N=1395)
First child did not die	0.136(N=5713)
Difference	0.039***

Notes: The Sample is restricted to women who gave birth to the first child between the year of 2000 and 2010. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.3: Effect of Child's Death on Delivery Behavior (DID)

Dependent vairiables:	Delivery assistance		Delivery at health facility	
	(1)	(2)	(3)	(4)
First child died	-0.018***	-0.007**	-0.105***	-0.025***
	(0.003)	(0.003)	(0.008)	(0.007)
Second child	-0.023***	-0.016***	-0.106***	-0.063***
	(0.002)	(0.002)	(0.004)	(0.003)
(First child died)*(Second child)	0.012***	0.012***	0.051***	0.039***
	(0.004)	(0.004)	(0.010)	(0.009)
Constant	0.974***	1.012***	0.634***	0.763***
	(0.001)	(0.021)	(0.004)	(0.044)
Observations	63069	60503	62959	60398
R-squared	0.004	0.003	0.012	0.028
Covariates		X		X
Fixed effect (District-level)		X		X
Clustered standard error	X	X	X	X

Notes: The Sample is restricted to women who gave birth to the first child between the year of 2000 and 2010. Robust standard errors clustered by districts with district fixed effects are in parenthesis. There are 10,210 districts. Covariates include age, age2, Muslim, rural, wealth level, and education level. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.4: Determinants of Child's Death and Delivery Behavior

Dependent vairbles:	First child died		Assistance at first delivery		First delivery at health facility	
	(1)	(2)	(3)	(4)	(5)	(6)
Assistance at first delivery	-0.022**	-0.030**				
	(0.011)	(0.012)				
First delivery at health facility	-0.020***	-0.017***				
	(0.004)	(0.005)				
Age	0.003	0.005*	0.003*	-0.001	0.026***	0.002
	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)
Age2	-0.000	-0.000	-0.000**	0.000	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Muslim	0.012***	0.010	-0.043***	-0.004	-0.092***	0.013
	(0.004)	(0.008)	(0.003)	(0.004)	(0.008)	(0.010)
Rural	0.008*	.	-0.014***	.	-0.155***	.
	(0.004)	.	(0.002)	.	(0.008)	.
Wealth index = Poorest	0.007	0.010	-0.026***	-0.010**	-0.237***	-0.125***
	(0.006)	(0.009)	(0.004)	(0.004)	(0.010)	(0.011)
Wealth index = Poorer	0.012**	0.012	-0.018***	-0.005	-0.166***	-0.096***
	(0.005)	(0.008)	(0.003)	(0.004)	(0.010)	(0.010)
Wealth index = Middle	0.008	0.005	-0.007***	-0.002	-0.089***	-0.071***
	(0.005)	(0.007)	(0.003)	(0.003)	(0.009)	(0.009)
Wealth index = Richer	0.011***	0.007	-0.004**	-0.000	-0.036***	-0.032***
	(0.004)	(0.006)	(0.002)	(0.002)	(0.007)	(0.007)
Highest education= None	0.069***	0.057***	-0.023***	-0.022***	-0.248***	-0.211***
	(0.007)	(0.010)	(0.003)	(0.004)	(0.011)	(0.012)
Highest education= Primary	0.048***	0.037***	0.004	-0.014***	-0.106***	-0.147***
	(0.007)	(0.009)	(0.002)	(0.003)	(0.009)	(0.011)
Highest education= Secondary	0.026***	0.020**	0.003*	-0.008***	-0.013*	-0.058***
	(0.006)	(0.008)	(0.002)	(0.002)	(0.008)	(0.010)
Constant	0.024	0.009	0.974***	1.011***	0.620***	0.770***
	(0.033)	(0.039)	(0.020)	(0.020)	(0.047)	(0.046)
Observations	44455	44455	44624	44624	44542	44542
R-squared	0.010	0.003	0.040	0.001	0.205	0.023
Mean of dependent variables	0.101	0.101	0.972	0.972	0.624	0.624
Fixed effect (District-level)		X		X		X
Clustered standard error	X	X	X	X	X	X

Notes: The Sample is restricted to women who gave birth to the first child between the year of 2000 and 2010. Robust standard errors clustered by districts with district fixed effects are in parenthesis. There are 10,210 districts. Covariates include age, age2, Muslim, rural, wealth level, and education level. Column (6)-(10) includes birth-order dummy. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.5: Effect of First Child's Death on Second Delivery

Panel A: Delivery Assistance

Sample:	Total			First child delivered without any assistance	
Dependent variables:	Assistance at second delivery				
	(1)	(2)	(3)	(4)	(5)
First child died	-0.006	0.004	0.015***	0.116***	0.069
	(0.005)	(0.004)	(0.005)	(0.044)	(0.049)
Assistance at first delivery		0.772***	0.674***		
		(0.017)	(0.024)		
Constant	0.951***	0.206***	0.339***	0.182***	-0.065
	(0.002)	(0.017)	(0.059)	(0.018)	(0.646)
Observations	16574	16390	15705	609	607
R-squared	0.000	0.450	0.356	0.014	0.058
Covariates			X		X
Fixed effect (District-level)			X		X
Clustered standard error	X	X	X	X	X

Panel B: Delivery Place

Sample:	Total			First child delivered at home	
Dependent variables:	Second delivery at health facility				
	(6)	(7)	(8)	(9)	(10)
First child died	-0.053***	0.015*	0.025**	0.039***	0.016
	(0.011)	(0.008)	(0.010)	(0.011)	(0.013)
First delivery at health facility		0.668***	0.412***		
		(0.006)	(0.013)		
Constant	0.528***	0.141***	0.448***	0.136***	0.402
	(0.006)	(0.005)	(0.105)	(0.005)	(0.256)
Observations	16550	16342	15660	7108	6843
R-squared	0.002	0.438	0.203	0.002	0.008
Covariates			X		X
Fixed effect (District-level)			X		X
Clustered standard error	X	X	X	X	X

Notes: The Sample is restricted to women who gave birth to the first child between the year of 2000 and 2010. Robust standard errors clustered by districts with district fixed effects are in parenthesis. There are 7,461 districts for the total sample analysis. For column 4 and 5, there are 442 districs, and for column 9 and 10, there are 3,855 districts. Covariates include age, age2, Muslim, rural, wealth level, and education level. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.6: Differential Effect of Child's Death by Timing

Sample:	Total		First child delivered without any assistance		Total		First child delivered at home	
Dependent variables:	Assistance at second delivery				Second delivery at health facility			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First child died within --- month since birth:								
1 month	0.006	0.015*	0.193***	0.092	0.054***	0.041***	0.082***	0.029
	(0.006)	(0.008)	(0.061)	(0.078)	(0.013)	(0.016)	(0.019)	(0.022)
2 month	0.003	0.012	0.034	0.005	-0.001	0.013	0.024	0.016
	(0.005)	(0.007)	(0.059)	(0.063)	(0.012)	(0.015)	(0.016)	(0.018)
3 month	0.004	0.023	0.193**	0.149	-0.035*	0.013	-0.014	-0.015
	(0.010)	(0.015)	(0.084)	(0.117)	(0.019)	(0.022)	(0.022)	(0.021)
4-6 month	-0.007	0.012	-0.057	0.028	-0.005	0.034	0.018	0.050
	(0.017)	(0.030)	(0.143)	(0.046)	(0.039)	(0.045)	(0.051)	(0.051)
Assistance at first delivery	0.772***	0.674***						
	(0.017)	(0.024)						
First delivery at health facility					0.667***	0.412***		
					(0.006)	(0.013)		
Constant	0.206***	0.340***	0.182***	-0.023	0.141***	0.445***	0.136***	0.399
	(0.017)	(0.059)	(0.018)	(0.652)	(0.005)	(0.105)	(0.005)	(0.254)
Observations	16390	15705	609	607	16342	15660	7108	6843
R-squared	0.450	0.356	0.024	0.069	0.438	0.203	0.004	0.009
Covariates		X		X		X		X
Fixed effect (District-level)		X		X		X		X
Clustered standard error	X	X	X	X	X	X	X	X

Notes: The Sample is restricted to women who experienced death of their own children and gave birth to the first child between the year of 2000 and 2010. Robust standard errors clustered by districts with district fixed effects are in parenthesis. There are 7,461 districts for the total sample analysis. For column 3 and 4, there are 442 districs, and for column 7 and 8, there are 3,855 districts. Covariates include age, age2, Muslim, rural, wealth level, and education level. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.7: Switching Behavior

Sample:	First child delivered with assistance		First child delivered at health facility	
Dependent variables:	Second delivery without assistance		Second delivery at home	
	(1)	(2)	(3)	(4)
First child died	0.001	-0.007	0.010	-0.009
	(0.003)	(0.005)	(0.012)	(0.016)
Constant	0.021***	-0.014	0.188***	0.011
	(0.001)	(0.046)	(0.005)	(0.154)
Observations	15781	15098	9234	8817
R-squared	0.000	0.002	0.000	0.015
Covariates		X		X
Fixed effect (District-level)		X		X
Clustered standard error	X	X	X	X

Notes: The Sample is restricted to women who gave birth to the first child between the year of 2000 and 2010. Robust standard errors clustered by districts with district fixed effects are in parenthesis. There are 7,382 districts for column 2, and 5,200 districts for column 4. Covariates include age, age2, Muslim, rural, wealth level, and education level. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2.8: Effect of "i-1"th Child's Death on Delivery for "i"th Child

Sample:	Total		At least one child died	Total		At least one child died
Dependent variables:	Assistance at "i"th delivery			"i"th delivery at health facility		
	(1)	(2)	(3)	(4)	(5)	(6)
Previous child died	0.002	0.010**	0.006	0.013	0.024***	0.029*
	(0.003)	(0.005)	(0.009)	(0.008)	(0.009)	(0.016)
Assistance at previous child delivery	0.757***	0.619***	0.380***			
	(0.017)	(0.025)	(0.073)			
Deliver previous child at health facility				0.672***	0.364***	0.110***
				(0.006)	(0.013)	(0.035)
Constant	0.242***	0.397***	0.573*	-0.013	0.519***	0.715*
	(0.018)	(0.059)	(0.321)	(0.008)	(0.105)	(0.403)
Observations	18598	17809	4388	18545	17759	4376
R-squared	0.436	0.294	0.342	0.445	0.162	0.307
Covariates		X	X		X	X
Fixed effect (District-level)		X	X		X	X
Clustered standard error	X	X	X	X	X	X

Notes: The Sample is restricted to women who gave birth to the first child between the year of 2000 and 2010. Previous child refers to "i-1"th child. Robust standard errors clustered by districts with district fixed effects are in parenthesis. There are 7,468 districts for the main analysis (column 2 and 5), and 2,709 districts for column 3 and 6. Covariates include age, age2, Muslim, rural, wealth level, and education level. Countries included in the analysis are Benin, Burkina Faso, Cameroon, Chad, Congo, CDR, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagaskar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Swaziland, Uganda, Zambia, and Zimbabwe. * significant at 10%; ** significant at 5%; *** significant at 1%

Chapter 3

Influence of Social Networks on Vaccine Take-up among Women in Rural Nigeria

3.1 Introduction

The role of social networks in vaccination behaviors among other health behaviors deserves attention because of the potential externalities of the disease within a social network that vaccination can prevent. Theoretically and practically, the effect of peers on one's vaccination decision can be positive or negative due to various mechanisms such as information sharing, cost sharing, imitation, and free-riding (Bodine-Baron, 2013; Philpson, 2000). In the context of developed countries, Rao et al. (2007) find positive peer effects on the perception of vaccine benefits as well as on vaccination behavior by using a random assignment of dormitory rooms among American undergraduates. On the other hand, Ibuka et al. (2014) find that vaccinations are discouraged among peers due to the free-riding problem using a lab experiment in the U.S.

Although the potential role of peers in effective disease control can be crucial, especially in developing countries where disease prevalences are high, there has not been a causal study of peer effect on vaccination in developing countries. This study is the first to causally examine the peer effect on vaccination in Africa.[1] Measuring the causal effect of social networks has proven challenging because the selection of peers is endogenous (Manski, 1993). However, recent studies have overcome this methodological issue by implementing experiments that can influence peers' behaviors exogenously. For example, Miguel and Kremer (2004) uses the random variation of the distribution of deworming drugs at school level and find that untreated students who are close to treated schools benefit from the spillover of the project. Godlonton and Thornton (2012) measure the effect of social networks on learning HIV results by using the exogenous variation of cash incentives offered to individuals.

This paper focuses on vaccination behaviors against tetanus among women at child-bearing age. Tetanus is a non-communicable disease; thus, I control for the potential free-riding problem to evaluate the peer effects. Nigeria, the study site, is one of twenty five countries where tetanus remains a major public health problem (WHO, 2013). Tetanus contributes to high neonatal mortality rate, up to 20 percent in Nigeria (Oruamabo, 2007). This is because fatality of neonatal tetanus reaches almost 100 percent without medical treatment, which is difficult to obtain in rural Africa (Blencowe et al, 2010). Neonatal tetanus is typically contracted at the time of delivery when the umbilical cord is cut with a non-sterile instrument, and tetanus-toxoid vaccine is the most effective way to prevent neonatal tetanus. However, the take-up of tetanus vaccines in Nigeria remains low: 52.8 percent (DHS, 2013). Eliminating the possibility of free-riding problem, this paper evaluates if peers

[1] Although Goldberg (2014) presents the relationship between social networks and vaccination behavior in Nigeria, her methodology does not identify a causal relationship because she has not taken into account that the formation of social networks is endogenous.

encourage an individual's vaccination.

This paper analyzes the effect of various social networks on one's vaccination decision as well as performs a detailed analysis on the characteristics of friends who have a stronger influence on one's vaccination in rural Nigeria. I analyze an experiment that randomized the amount of cash incentives, conditional cash transfer (CCT), to women to receive a tetanus-toxoid vaccination at an assigned clinic. The random allocation of cash incentives to individuals allows the causal study of peer effect on vaccination decision because I have previously observed that the randomly-assigned cash incentives strongly increased the likelihood that one received a vaccination.

I find that social networks have a strong influence on vaccine take-up. Social networks among villagers, neighbors, and friends all significantly increase one's vaccine take-up. For example, if a respondent has one additional friend who has been vaccinated, it increases the likelihood of her vaccination by 17.2 percentage points. I also address the potential mechanism of the positive effect of social networks; social networks enhance vaccination not through cost sharing or through social learning about others' behavior, but possibly through information sharing or collective decision making. Although this is not the first causal study of the social network, my result adds to the literature by methodologically overcoming endogeneity through using a random variation of peers' behavior and by finding very strong peer effects on vaccination.[2,3]

[2] It is important to contrast the difference in the role of social networks that I find on a health behavior and what Miguel and Kremer (2007) find. While they find a negative effect of social networks on deworming pill take-up in Kenya, my study finds a positive effect on vaccination take-up. This contrast can be attributed to the difference in nature of products. Deworming pills benefit the treated people, but they also greatly benefit others in the community. As a result, the take-up of deworming pills might decrease if people free-ride on this public good. On the other hand, tetanus-toxoid vaccines only benefit the vaccinated individuals because tetanus is not transmitted from person to person. Thus the take-up increases once people realize the benefit of the vaccine through their peers.

[3] The positive effect of social networks is specific to tetanus-toxoid vaccine as tetanus is not a contagious disease. Whether take-up of other vaccines against contagious diseases

Among other social networks, this paper further evaluates the effect of a best friend's vaccination on one's vaccination behaviors. I find that the best friend's vaccination increases one's vaccination probability by 25.8 percentage points. But the influence of a best friend's vaccination differs greatly depending on the distance to the clinic and the distance between the respondent and her best friend. The best friend's vaccination status increases the likelihood that one receives a vaccination only if the distance between one's house and the health clinic is more than 500 meters. If the distance to the health clinic is less than 500 meters, the best friend no longer influences one's vaccination decision. I also find that the influence of the best friend receiving a vaccine is 62.6 percentage points more if the distance between a respondent's house and her best friend's house is close (less than 25 meters). On the other hand, the best friend's vaccination has no effect on one's vaccination decision if the friends live more than 25 meters apart. Friends matter when the coordination to visit a clinic together eases psychological costs and the coordination is easy.

Lastly, I find that the influence of best friend's vaccination decision depends on prior beliefs about vaccine safety. The best friend's vaccination increases the likelihood of one's vaccination by 80.7 percentage points if both the respondent and her best friend do not have concerns about the side effect of the vaccination. On the other hand, the best friend's vaccination does not affect one's vaccination decision if either the respondent or her best friend has concerns about the side effect of the vaccination.

Overall, my results suggest important policy implications. My finding of strong effects of peers as well as cash incentives on vaccine take-up implies that governments should invest more in CCTs for vaccination. Social benefits of investing in CCTs for vaccines are higher if the peer effect is taken into

have positive peer effects is beyond the scope of this study, but it is worth examining in future work.

consideration because recipients of CCTs positively influence their peers for vaccination.

This paper also suggests that different policies might be effective, depending on the access to clinics and friends, and the common beliefs in each region. First, we should encourage social interactions especially in locations where the access to the health clinic is difficult. For example, promoting the coordination of transportation among people in remote villages to visit the clinic might increase their health service utilization. Second, relying only on the influence of social networks would not be sufficient to increase vaccination rate evenly, because peers are influential only if they live close by. Furthermore, peers' vaccinations do not influence one's vaccination decision if she has prior concerns about vaccination. Along with promoting coordination among villagers for the clinic visit, it might be important to carry out the information intervention to emphasize the benefits of vaccination especially in remote areas to maximize the influence of social networks.

3.2 Experiment and Data

3.2.1 Setting

This study is based on a larger project to measure the relative importance of psychic costs of vaccination, monetary costs, and salient disease information as potential barriers to vaccination in rural Nigeria. I conducted the larger study in Jada local government area, which exhibited the lowest tetanus toxoid vaccination rate in Adamawa state, one of the northeastern states.

This project was conducted in March through May, 2013. The sample was drawn from three-stage sampling. First, 10 health clinics were selected in a way that they were geographically spread across Jada local government. There was a total of 11 wards (9 rural wards and 2 urban wards) spanning all the villages in Jada and the study exclusively focused on 9 rural wards with each ward having 1 to 5 public health clinics. I selected the main health clinic from each ward with the exception of one large ward under which I selected 2 clinics, which brought the total to 10 clinics for my study.

Second, I selected a total of 80 villages which fell within one of the catchment areas of each clinic. Catchment areas of each health clinic were defined by the primary healthcare development agency which was responsible for national immunization campaigns. All the villages within a catchment area of each health clinic were selected if the village had more than 10 households and the total number of villages within a clinic's catchment area did not exceed 15. If it did, the priority was given to villages with the furthest distance from the health clinic.

Third, one eligible woman, who was aged 15 to 35, was selected from each household in each village. The survey team visited all the households in each village to find out if there were any eligible women. A woman was ineligible if she had received a tetanus vaccination in the 6 months prior to the time of the survey so as to avoid overdose; the second dose of the tetanus vaccine should be given to individuals at least 6 months from the first dose. In cases where there was more than one eligible woman in one household, the first priority was given to pregnant women who had not received tetanus-toxoid vaccination in the past 6 months. If there were no eligible pregnant woman in the household, then the second priority was given to women who had never received a tetanus vaccination before. If we still did not find any eligible women with a priority, then women who had not receive a tetanus vaccine in the past 6 months were invited to participate in the survey. If there was more than one woman who was eligible under the same priority, then we randomly picked one of the eligible women by selecting the first one in alphabetical order of the first name. On average, each health clinic covered 249 respondents from 9.6 villages in my study.

3.2.2 Experimental Design

The larger study randomized several factors: the amount of cash incentives, the condition of cash incentives, and the salience of information. I found that a small cash incentive ($2) increased the vaccine take-up by almost 20 percentage points, from 50 percent. On the other hand, two different conditions under which a respondent could receive cash incentives, either clinic attendance or vaccination at the clinic attendance, did not result in difference in the clinic attendance rate. The salient information which emphasized the severity of tetanus did not promote vaccination behavior, either. Thus, this paper focuses only on the random variation in the amount of cash incentives offered to individuals because other factors did not influence one's vaccination decision (Sato, 2015).

I randomly varied the amount of conditional cash transfer (CCT) offered to each respondent. The probability of one being offered each amount of cash incentives was roughly the same in each village. The amount of money offered was randomly assigned to each respondent: either 5 naira (approximately 3.3 US. cents), 300 naira (2 US. dollars) or 800 naira (5.3 US. dollars). As a reference, the average daily earnings per household is approximately 1,000 naira and that per person is 144 naira in my study. The average transportation cost to and from the health clinic is about 250 naira among those who need to pay for the transportation while 50 percent of the sample do not pay for the transportation in my study.

Although I designed the study so that the probability of one being offered each amount of cash incentives is roughly the same in each village, the nature of my study creates a village-level variation of the percentage of respondents who received the highest amount of CCT. This is because the assignment of the amount of CCT to each respondent was randomly determined by interviewers picking a questionnaire in front of each respondent, which indicated a randomly-assigned amount of cash incentives in the middle of the pages of each questionnaire. In other words, the assignment of the amount of CCT to each respondent was not determined beforehand.

3.2.3 Data

Social Networks

This study collected information about social networks at the baseline survey. Namely, this study defines villages, neighbors, and friends as social networks. Below I explain how I collected the information.

Village

I use the pre-determined unit of the social network, village, to identify the peer effect. The average number of women the study covered in each village was relatively small, the total number of women who were in the study in a village was 31.2 on average. Because the assignment of each treatment was random at an individual level and the nature of the treatment assignment created a variation in the proportion of respondents who received each amount of CCT by village, the peer effect on vaccination behavior is identified using such village-level random variations. The proportion of respondents receiving the highest amount of cash transfer (800 naira) ranges from 18.2 percent to 60 percent with the average of 34.9 percent.

Neighbors

Literature suggests that the village might not be a correct unit in measuring the spillover effect because information might spread only within the neighborhood (Godlonton and Thornton, 2012). This study measured the GPS coordinates of each respondent's house in order to analyze the spillover effect within a closer geographical proximity than within a village. Because the assignment of treatment status to respondents was random at an individual level, the random assignment rule should also apply to their neighbors. This study focuses on the neighbors who lived within 100 meters from each respondent.[4]

Friends

In addition to geographical information, this project collected unique data on friends for each respondent. Each respondent was asked to list the full name of her friends in the same village who fell within the 6 categories: a best friend, a friend whom she admires, a friend whom she talks about health issues with, a friend whom she goes to health clinic together with, a friend whom she visits when the friend is sick and a friend who visits her when she is sick. Respondents were asked to list only one name for each category, but the name could overlap across the different categories.

Data on listed friends was matched to names of respondents in the study. The matching was done manually to increase the precision because misspelling of names was common in the survey and at many times, there was more than one way to correctly spell each name. Furthermore, the total number of participated women in each village to find the match from was not large (31.2 women per village on average).[5]

Among six friend-categories, the matching rate was relatively similar. Approximately 25 percent of the names listed in each category were matched to respondents in my study while 1.5 percent of respondents did not provide any name for each category. The rest of approximately 73.4 percent of respondents who listed the name of friends in each category were not matched with any names of respondents. Reasons why names of friends listed were

[4] I also check the robustness of the analysis by using other distance such as 300 meters, 500 meters, and only the closest neighbor. I find that the main results do not change even when I use the different definition of neighborhood based on the distance.

[5] I also coded each name of friends to match with respondents' names to check the precision of the manual matching. The manual matching achieves the higher matching rate.

not matched with any names who were also in the survey include that the friend lived in a household that the survey team did not visit, or that the friend was not eligible. I did not conduct a census which would have enabled me to identify the reasons of unmatching because I would have known the names of all the residents in each village.

I use the variation of vaccination behaviors among friends who also participated in the study to evaluate the effect of friend's vaccination status on the likelihood that one receives a vaccine. This analysis is possible because the vaccination decisions by friends have been randomly induced with cash incentives, which were randomly assigned. Whenever I analyze the effect of friends using the total sample, I treat friends who are outside of the study as though they have not received a vaccine, in order to evaluate the lower bound of the effect of friends.

Descriptive Statistics and Balancing Tests

My analysis of 3 social networks (village, neighborhood, and friends) is based on 2,482 eligible women from a larger study. On average, one respondent had about 13 neighbors who were also respondents of the study within 100 meters from her house. Among neighbors, around 34 percent of neighbors were offered the highest CCT. While a respondent could list up to 6 names of her friends, on average respondents listed 0.36 friends who were also in the study. Among respondents who had at least one friend participated in the study, the average respondent listed 1.15 friends. The proportion of friends who were offered the highest CCT was about 30 percent among friends who were in the study (Table 3.1 Panel A).

The proportion of neighbors who were offered the highest amount of CCT was the lowest among respondents who were offered the highest amount of CCT. This is because each village had approximately the equal proportion of respondents with each amount of cash incentives. The proportion of friends who were offered each amount of CCT, on the other hand, was not statistically different by treatment status of respondents. In the analysis, imbalances are controlled with the village fixed effect.

In addition to evaluating the effect of various peers, I conduct a detailed analysis of best friends. I do that by restricting the sample to 624 women whose best friends were also the participants of the larger study. Because the sample for this analysis is restricted to respondents who had friends participating in the study, there might be a selection which violates the external validity. However, this sample selection would not violate the internal validity because the treatment status assigned to respondents and friends are random.

Table 3.1 Panel B shows the summary statistics of respondents who had their best friends in the study by the amount of cash incentives randomly assigned to each respondent. On average respondents were 25 years old and around 45 percent of the sample were Muslim. More than half of the women (46.6 percent) did not receive any form of education. Many respondents, 43 percent, had paid work and the average household earning last month was 6,180 naira (approximately 41.2 US dollars). 15 percent had never been married and 76.7 percent had at least one child. Around 16 percent of respondents were pregnant at the time of baseline survey. The majority of respondents, 73.7 percent, had previously visited the health clinic which was assigned to each respondent under this study and the distance to the clinic was on average 1.7 kilometers. Approximately 20 percent of respondents lived within 500 meters from the health clinic and another 25 percent of respondents lived within 500 meters to 1.5 km from the clinic. Overall, 40.8 percent of women had ever received tetanus-toxoid vaccination at least once.

Characteristics among 624 respondents who have their friends in the survey are similar to the characteristics among the total sample of 2,482 women from the larger study (Table A3.1). However, there are some differences to be noted. Around 5 percentage points more of respondents with friends surveyed were non-Muslim. It suggests that Muslim women might have been constrained to have friends. I also find that although insignificant, respondents whose friends also participated in the larger survey had around 300 naira ($2) more of the average household earning per capita in the previous month than the average among the total sample, they were more likely to have received at least some form of formal education, and were more likely to have received the tetanus vaccination prior to the baseline survey. This is suggestive that women who are socially connected have better economic and social outcomes.

Table 3.1 Panel C shows the characteristics of respondents' best friend. Roughly 35 percent of best friends received the highest amount of CCT. Twenty-five percent of respondents lived within 25 meters from their best friends, and another 25 percent lived more than 135 meters away from their best friends.

Randomization check in Table 3.1 (Panel B and C) finds very few differences between treatment groups. For all the demographic variables listed above, I could not reject the equality of means between each treatment except the pregnancy status. On the other hand, I find that pregnancy status is positively correlated with the amount of CCT offered. I control for pregnancy status in all my specifications.

3.3 Peer Effects

In this section, I study the effect of various social networks on vaccination take-up. The units of social networks I use in this study are village, neighborhood, and friend network. I overcome the methodological challenge of measuring the effect of social networks by using the exogenous variation of the amount of cash incentives offered to each peer which affected peers' vaccination decision. I find that peers' vaccination behaviors within all the social networks causally increases one's vaccination take-up to a great extent.

3.3.1 Specification

I estimate the peer effect on one's vaccination take-up with the following regression:

$$Y_{ij} = \alpha + \beta_1 NumVaccinated_{ij} + \beta_2 NumberWomen_{ij} + X_{ij}{}'\mu + \epsilon_{ij} \quad (3.1)$$

where $NumVaccinated_{ij}$ is the number of peers who received vaccination in a village, within a neighborhood or among friends, and $NumberWomen_{ij}$ is the total number of women in the social network. In addition to individual-level controls such as age and the education level that I introduced for the previous regression specification, I also include the treatment variables that each respondent received.

Because the independent variable $NumVaccinated_{ij}$ is endogenous, I use an instrumental variables strategy to causally measure the peer effect on vaccination, relying on the fact that peers were randomly offered different amount of CCT and that the amount of CCT strongly affect one's vaccination decision. I instrument $NumVaccinated_{ij}$ in (3.1) with the number of peers who received the highest amount of CCT. The first stage is

$$NumVaccinated_{ij} = \alpha + \beta_1 NumCCT800_{ij} + X_{ij}{}'\mu + \epsilon_{ij} \quad (3.2)$$

where $NumCCT800_{ij}$ is the number of respondents who were offered the highest amount of CCT (800 naira) in a village, within a neighborhood (100 meters radius), or among friends. I only use the highest amount of CCT because this has the strongest effect on vaccine take-up.

3.3.2 Strong Effect of Social Networks

Because I use IV estimator to identify social networks, I first show the strong result of the first stage. There is a large and strong effect of the highest amount of CCT on the vaccination take-up among the social networks (Table A3.2). Specifically, one additional peer in a village offered the highest amount of CCT increases the number of respondents receiving a vaccine in the village by 2.3 people. Similarly, one additional neighbors with the highest CCT increases the number of respondents receiving a vaccine in the neighborhood by 0.54. Finally, if one additional friend is offered the highest CCT, it increases the number of friends receiving the vaccination by 0.25. These results, that peers with higher cash incentives increases their likelihood of vaccination within any of the three social networks (village, neighbors, and friends), are important first stage estimates in order for the instrument variable strategy to be valid.

Using IV regressions, I find strong evidence of positive peer effects on vaccination take-up (Table 3.2).[6] If the number of women receiving a vaccination increases by one in one's village, then a respondent is more likely to receive a vaccine by 2.4 percentage points (Table 3,2 column 5). Similarly, if the number of women who received a vaccination increases by one in one's neighborhood, then the probability that a respondent receives a vaccine increases by 3.6 percentage points (Table 3.2 column 6). Finally, if one additional friend received a vaccination, it increases one's vaccination take-up by 17.2 percentage points (Table 3.2 column 7). Because the maximum number of friends who were offered the highest amount of CCT is two, I also consider the non-linear relationship between the number of friends and one's vaccination take-up (Table 3.2 column 8). I find that friend's vaccination increases one's vaccination likelihood at the increasing rate.

[6]OLS regressions reveal the consistent results with IV regressions.

The comparison of the magnitude of peer effects among the different definitions of social networks verifies that friends have the strongest influence on vaccination behavior. The effect of neighbors on vaccination (3.6 percentage points) is stronger than that within village (2.4 percentage points), although the difference is statistically insignificant. On the other hand, the effect of a friend's vaccination on one's vaccination take-up (17.2 percentage points) is much larger than the peer effect within a village and among neighbors. The network of friends has a stronger influence on the decision to vaccinate than the village network.

Here I examine possible channels through which social networks may affect vaccination behavior, with a focus on information sharing, cost sharing, and social learning from experience. First, information sharing should not matter in this setting because all the respondents have received some information about the vaccine. However, there is additional suggestive evidence that knowledge about tetanus and vaccine is promoted among respondents through peers, especially friends. Table A3.3 shows that respondents are more likely to correctly state the causes and symptoms of tetanus (column 13) and are more likely to have higher perception of vaccine efficacy if they have friend who have received a vaccine beforehand. Second, I find that peers do not enhance vaccination behavior by social learning about others' behavior. Table A3.4 presents that peers' vaccination take-up prior to the intervention to respondents do not increase respondents' vaccination take-up. Social learning about others' behavior do not enhance vaccination, or imitation is not the mechanism of positive spillover effect. Lastly, I have not found evidence that respondents share costs of clinic visits nor do they share cash incentives. Table A3.5 shows that the total amount of CCT offered to peers do not change a respondent's decision to vaccinate.

The last possibility is that the vaccination decision is made collectively among peers. In fact, among respondents whose friends received a vaccine, 34.6 percent of them visited a clinic together with their friends. This is suggestive that peers gather after the intervention and then decide if they want to receive vaccinations.

Overall, I find that social networks strongly enhance vaccination take-up and the friend network is the most influential on the decision to get vaccinated. Suggestive evidence shows that mechanisms of positive peer effects include information sharing and collective decision making, rather than cost sharing or social learning from others' experience.

3.4 Differential Effect of Best Friend

Previous section reveals the strong effect of friends on vaccination decision. This section performs a detailed analysis of friends. Particularly, I focus on best friends to evaluate the differential effect of such friends getting a vaccine on one's vaccination behavior by various factors such as distance and belief. I find a strong effect of a best friend's vaccination on one's vaccination but that the effect of a best friend's vaccination varies depending on various factors, such as distance to a clinic and between friends' house, and beliefs about vaccine safety.

3.4.1 Empirical Strategy

I estimate the effect of having friends vaccinated on one's vaccination take-up with the following regression:

$$Y_{ij} = \alpha + \beta_1 FriendVaccinated_{ij} + X_{ij}{}'\mu + \epsilon_{ij} \tag{3.3}$$

where Y_{ij} is an outcome variable which indicates if a respondent i received a vaccine. $FriendVaccinated_{ij}$ is a dummy variable which indicates if a respondent i's friend has received a vaccine. X includes the size of village and a set of individual controls such as age, the education level as well as the treatment status of the respondent.

Because the independent variable $FriendVaccinated_{ij}$ is endogenous, I use an instrumental variable strategy to causally measure the peer effect on vaccination, relying on the fact that respondents' friend were randomly offered some amounts of CCT and that the amount of CCT strongly affects one's vaccination decision. I instrument $FriendVaccinated_{ij}$ in (3.3) with a dummy variable to indicate if the friend was offered the highest amount of CCT. The first stage is

$$FriendVaccinated_{ij} = \alpha + \beta_1 FriendCCT800_{ij} + X_{ij}'\mu + \epsilon_{ij} \tag{3.4}$$

where $FriendCCT800_{ij}$ is a dummy variable to indicate if the friend was offered the highest amount of CCT (800 naira).

I evaluate the differential effect of friend in the following regression framework:

$$Y_{ij} = \alpha + \beta_1 FriendVaccinated_{ij} + \beta_2 H_{ij} + \beta_3 (FriendVaccinated * H)_{ij} + X_{ij}'\mu + \epsilon_{ij} \tag{3.5}$$

where H_{ij} is a variable which potentially changes the average effect of the friend's vaccination. In this study, I particularly focus on the distance to the health clinic, the distance between a respondent's house and her friend's house, and a respondent's belief about vaccine side effects.

3.4.2 Results

Effect of Best Friend

It is natural to think that the extent to which a friend influences a person varies depending on the strength of friendship (Oster and Thornton, 2012).

This study first compares the effect of any friend getting vaccinated and that of a best friend getting vaccinated.

Table 3.3 shows the effect of friends' vaccination on one's vaccine take-up. Using IV estimator, column 4 shows that using the total sample of 2,482 women from the larger study, if any of a respondent's friend has received a vaccine, it increases the likelihood that the respondent also receives a vaccine by 11.4 percentage points. Once I restrict the sample to respondents whose friends also participated in the survey, any friend getting vaccinated increases one's vaccination probability by 20.6 percentage points (Column 2). Friends' vaccination strongly influenced one's vaccination decision.

I find that the effect of having a vaccinated friend is much larger if I restrict the sample to women whose friends are also in the survey than when I use the total sample (Table 3.3 column 4 and 5). This result indicates that if one's friend is not in the survey, the respondent is less likely to receive a vaccine than when her friend is in the survey but she is not vaccinated.

Among various definitions of friends, I find that a best friend's vaccination particularly has a strong effect on one's vaccination decision (Table 3.3 column 6). If a respondent's best friend has received a vaccine, it increases one's likelihood of vaccination by 25.8 percentage points. This seemingly large effect is potentially due to the fact that all the women in this analysis have received some cash incentives, ranging from 5 naira to 800 naira. Put the result differently, I find that if a respondent has an incentive to get vaccinated, she is 25.8 percentage points less likely to receive a vaccine if her best friend does not go.[7]

Because the effect of a best friend's vaccination was large, I focus on the differential effect of a best friend in the following analysis.

[7] The analysis which examines the effect of friend on vaccination among women who did not receive any treatment is not possible in this study, because I did not collect the data on vaccination decision among women who did not participate in the survey in each village

Interaction between Best Friend's Vaccination and CCT

My estimate of the impact of the best friend's vaccination indicated the positive effect on one's receiving a vaccine. It is important for policy purposes to evaluate if having a best friend vaccinated can substitute cash incentives in promoting vaccination behavior. Another possibility is that a best friend's vaccination is influential only when one receives cash incentives for vaccination.

Table 3.4 shows the substitution of the effect of the amount of CCT a respondent received and best friend's vaccination. Although the analysis find that none of the coefficients is significant presumably because it suffers from under-power issue, the result shows suggestive evidence that the effect of the friend's vaccination substitutes the effect of CCT. Especially, if a respondent was offered the medium amount of CCT (300 naira, or $2), the effect of the best friend's vaccination on one's vaccination decision is lower by 12.8 percentage points than when she was offered the lowest amount of CCT. And if a respondent was offered the highest amount of CCT (800 naira, or $5), the effect of the best friend's vaccination is lower by 17. 7 percentage points.

Distance to Health Clinic

The distance to a health clinic is one of the major reasons for low health service utilization (Thornton, 2008). The best friend might help one mitigate the cost of long distance to a clinic, either psychologically or financially, while a woman might not need her peers if she has an easy access to a health clinic because the cost of attending the clinic is not large.

Table 3.5 (column 1) shows the differential effect of best friend's vaccination by the distance to a health clinic. I construct a dummy variable to indicate the distance to a health clinic, and the cut-off of the distance variable I use is every 25 percent of the distribution of the distance.

If the distance from the respondent's house to a health clinic is less than 500 meters, the effect of a best friend's vaccination is statistically and economically null. However, the effect of a best friend's vaccination gets larger as the distance to a health clinic gets longer. If the distance to a health clinic is within 0.5 to 1.5 km, the influence of the best friend's vaccination is 14.3 percentage points more than the case if the distance is less than 500 meters, although the effect is insignificant. If the distance to a health clinic is within 1.5 to 2.5 km, the influence of the best friend's vaccination is 89.9 percentage points more than the case if the distance is less than 500 meters.

This effect is extremely large, but the effect of the distance to the clinic (1.5 to 2.5 km) is also very large: among respondents whose best friends did not receive a vaccine, if the clinic is 1.5 to 2.5 km away from one's house, the likelihood of one's receiving a vaccine is 73.6 percentage points less than if the distance is 500 meters or less. Thus the best friend's vaccination is 16.3 percentage points among respondents who live within 1.5 to 2.5 km from the clinic.

This result indicates that social networks influence one's vaccination decision especially when the distance to the clinic is far. One of the potential reasons why the social network matters when the distance to the clinic is far is that peers help one overcome the financial and psychological barriers to visit the health clinic. If the health clinic is far, one might have stronger incentives to visit the clinic together with her peers so that they share the transportation cost. Peers might also help mitigate her psychological costs to visit a health clinic when it is far if she travels together with her peers. In fact, I find that respondents are around 15.9 percentage points more likely to visit the health clinic together with her friend if the clinic is within 500 meters to 2.5 km away from the respondent's house than if the clinic is less than 500 meters away (Table A3.6 column 1). This is suggestive evidence that social networks influence one's vaccination when the clinic is located far because peers mitigate the cost of the clinic visit by attending the clinic together.

Distance between Best Friends' House

Geographical proximity is a strong factor that one gets influenced by another. I presented the result that a woman living nearby to someone who received a vaccine was more likely to receive a vaccine (Table 3.2 column 5). The question I evaluate here is if friends can be equally influential no matter where they are, when the friendship is strong (best friend). I find that the influence of a best friend's vaccination quickly fades as the distance between friends' house gets longer.

Table 3.5 (column 2) shows the differential effect of a best friend's vaccination by the distance between a respondent's house and her best friend's house. I construct a dummy variable to indicate the distance between a respondent and her best friend in a similar way as the one for the distance to a health clinic. The cut-off of the dummy variable I use is every 25 percent of the distribution of the distance.

If the distance between a respondent's house and her best friend's house is less than 25 meters, the best friend's vaccination increases one's probability of getting vaccinated by 62.6 percentage points. On the other hand, as the distance between a respondent's house and her best friend gets longer, the influence of the best friend's vaccination on vaccination gets weaker. In fact, if the best friend lives more than 25 meters away from where the respondent lives, the best friend's vaccination does not affect one's vaccination decision. Specifically, if the best friend lives within 25 to 55 meters from the respondent, the influence of the best friend's vaccination is 13.6 percentage points less than the case when the best friend lives within 25 meters, and if the best friend lives more than 135 meters away from the respondent, the influence of the best friend's vaccination is 83.5 percentage points less than the case when the best friend lives within 25 meters.

This result indicates that social networks influence one's vaccination decision especially when the distance between best friends is close. Best friends who live close are easier to coordinate to visit the clinic together than those who live far, and as a result, friends who live nearby influence one's vaccination decision more than friends who do not. As suggestive evidence, Table A3.6 (column 2) shows the distance between a respondent's and her best friend's house is negatively correlated with the probability that a respondent attends a clinic together with a friend. If the best friend lives more than 135 meters away, the respondent is 25.6 percentage points less likely to visit the clinic together with her friend than when the best friend lives within 25 meters. Living nearby to her best friend promotes one to attending the clinic together with her best friend, and that promotes more vaccination behaviors.

Concerns for Vaccine Safety

Perceptions greatly influence vaccination behaviors across the globe (Larson et al., 2014). This section examines if other people's perceptions affect one's vaccination behavior. If a best friend's vaccination behavior is a significant determinant of one's behavior, the best friend's perception might influence one's behavior as well.

Table 3.6 (column 1) shows the differential effect of the best friend's vaccination by the subjective belief of a respondent about vaccine safety. Specifically, if the respondent thinks that vaccines do not have side effects, then the vaccination by her best friend increases the likelihood that one receives a vaccine by 49.5 percentage points. On the other hand, the best friend's vaccination does not affect one's vaccination decision if the respondent think that the vaccination has side effects.

Similarly, column 2 shows that if the respondent's best friend thinks that vaccines do not have side effects, then the vaccination by her best friend increases the likelihood that one receives a vaccine by 37.0 percentage points. On the other hand, the best friend does not affect one's vaccination decision if the respondent's best friend thinks that the vaccination has side effects.

Table 3.6 (column 3) shows that if either a respondent or her best friend thinks that vaccines have side effects, the effect of the best friend's vaccination on one's vaccination decision is 66.2 percentage points less than when both the respondent and her friend think that vaccine have no side effects. These results indicate that the effectiveness of social networks on vaccination depends largely on one's belief on vaccination.

Finally, Table A3.7 shows the correlation between a respondent's belief and her friend's belief by the distance between their houses. I find that there is a strong positive correlation between beliefs between a respondent and her best friend if the distance is less than 25 meters. However, this positive correlation of the belief drastically weakens as the distance between a respondent and her friend gets longer. Results on the differential effect of a best friend's vaccination by the distance between friends' houses and by one's belief reveal that both friends' networks and distances are important factors to affect one's vaccination behavior.

3.5 Conclusion

Although the role of social networks in health behaviors received increasing attentions in the literature, it is important to evaluate if there are differential effects of peers depending on their characteristics. This paper examines the effect of various social networks as well as the differential effect of the best friend's vaccination on one's vaccination decision.

I find that social networks increase vaccination significantly and especially the influence of a friend's vaccination is large on one's vaccination decision. Among best friends, their vaccination decisions influence one's vaccination decision if one resides more than 1.5 km away from the health clinic. The best friend's vaccination influences one's vaccination decision only when the best friend lives close to the respondent. Finally, the best friend's vaccination status does not affect one's vaccination decision if either the respondent or her best friend has concerns about side effects of vaccines.

This exercise reveals that the friend network is influential on vaccination behaviors but at the same time, the distance to a health clinic or to a friend's house and one's belief determine how strong the effect of friend's vaccination could be.

Past studies have emphasized the importance of peers in promoting health behaviors without detailed examinations on what kind of peers has more influence than others. I contribute to social network literature because this is the first study in measuring the causal effect of social networks on vaccination in Africa.

I also contribute to the literature by evaluating the differential effect of peers' vaccination by the distance to health clinics, the distance between peers, and by one's belief. Results of the study reveal several important policy implications. First, interventions to promote health behaviors using peers should target population which has a difficult access to health facilities. Second, peers might not be sufficient to evenly promote health behaviors. It is crucial to implement information campaign to emphasize the benefit of health behaviors in order for social networks to effectively function to improve health behaviors particularly in remote areas where the health service utilization as well as the perceived benefit of the health service is low.

References

Abdulraheem, S., Onajole, T., Jimoh, G., and Oladipo, R. (2011). Reasons for incomplete vaccination and factors for missed opportunities among rural

Nigerian children. *Journal of Public Health and Epidemiology*, 3(4).

Abhyankar, P., O'Connor, B., and Lawton, R. (2008). The role of message framing in promoting MMR-vaccination: Evidence of a loss-frame advantage. *Psychology, Health and Medicine*, 13(1).

Adelekan, M. and Lawal, R. (2006). Drug use and HIV infection in Nigeria: A review of recent findings. *African Journal of Drug and Alcohol Studies*, 5(2).

Banerjee, A., Duflo, E., Glennerster, R., and Kothari, D. (2010). Improving immunization coverage in rural India: A clustered randomized controlled evaluation of immunization campaigns with and without incentives. *British Medical Journal*, 340(c2220).

Barham, T. and Maluccio, J. (2009). Eradicating disease: The effect of Conditional Cash Transfers on vaccination coverage in rural Nicaragua. *Journal of Health Economics*, 28(3).

Blencowe, H., Lawn, J., Vandelaer, J., Roper, M., and Cousens, S. (2010). Tetanus toxoid immunization to reduce mortality from neonatal tetanus. *International Journal of Epidemiology*, 39.

Bloom, D., Canning, D., and Weston, M. (2005). The value of vaccination. *World Economics*, 6(3).

Brenzel, L., Wolfson, J., Fox-Rushby, J., Miller, M., and Halsey, A. (2006). Vaccine-preventable diseases. *World Bank*, 20.

Buor, D. (2003). Analysing the primacy of distance in the utilization of health services in the Ahafo-Ano South district, Ghana. *International Journal of Health Planning and Management*, 18(4).

Caplin, A. (2003). Fear as a policy instrument: Economic and psychological perspectives on intertemporal choice. *Russell Sage Foundation*.

Chaudhury, N., Hammer, J., Kremer, M., Muralidharan, K., and Rogers, F. (2004). Teacher and health care provider absenteeism: A multi-country study. *World Bank*.

Commission, N. P. and Macro, I. (2009). Nigeria demographic and health survey 2008. *National Population Commission and ICF Macro*.

Currie, J. (2006). The take-up of social benefits. *Russell Sage*.

Deacon, D. and Abramowitz, J. (2006). Fear of needles and vasovagal reactions among phlebotomy patient. *Journal of Anxiety Disorders*, 20(7).

Dillard, P. and Anderson, W. (2004). The role of fear in persuasion. *Psychology and Marketing*, 21(11).

Dupas, P. (2011a). Do teenagers respond to hiv risk information? evidence from a field experiment in Kenya. *American Economic Journal: Applied Economics*, 1.

Dupas, P. (2011b). Health behavior in developing countries. *Annual Review of Economics*, 3.

Ehreth, J. (2003). The global value of vaccination. *Vaccine*, 21.

Essen, G. V., Kuyvenhoven, M., and R. De Melker, R. (1997). Why do healthy elderly people fail to comply with influenza vaccination? *Age and Ageing*, 26.

Fritsche, G., Soeters, R., and Meessen, B. (2014). Performance-based financing toolkit. *World Bank*.

Gauri, V. and Khaleghian, P. (2002). Immunization in developing countries its political and organizational determinants. *The World Bank Development Research Group Policy Research Working Paper*, (2769).

Gerend, M. and Shepherd, J. (2007). Using message framing to promote acceptance of the human papillomavirus vaccine. *Health Psychology*, 26(6).

Gertler, J. (2004). Do conditional cash transfers improve child health? evidence from PROGRESA control randomized experiment. *American Economic Review*, 94.

Goldberg, A. (2014). Immunization decisions in rural northern nigeria. *Dissertation at Columbia University.*

Goldstein, M., Zivin, G., Pop-Eleches, J. H. C., and Thirumurthy, H. (2013). The effect of absenteeism and clinic protocol on health outcomes: The case of mother-to-child transmission of HIV in Kenya. *American Economic Journal: Applied Economics*, 5(2).

Grossman, M. (2000). The human capital model. *Handbook of health economics.*

Harris, C. (2010). Feelings of dread and intertemporal choice. *Journal of Behavioral Decision Making*, 25(1).

IRIN (2013). Analysis roots of polio vaccine (april 4, 2013). roots of polio vaccine suspicion. *IRIN News.*

Jepson, C. and Chaiken, S. (1990). Chronic issue-specific fear inhibits systematic processing of persuasive communications. *Journal of Social Behavior and Personality*, 5.

Jheeta, M. and Newell, J. (2008). Childhood vaccination in Africa and Asia: the effects of parents' knowledge and attitudes. *Bulletin of the World Health Organization*, 86(6).

Job, S. (1988). Effective and ineffective use of fear in health promotion campaigns. *American Journal of Public Health*, 78(2).

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica*, 47.

Kaufmann, J. and Feldbaum, H. (2009). Diplomacy and the polio immunization boycott in northern Nigeria. *Health Affairs*, 28(4).

Kimmel, S., Burns, T., and Zimmerman, R. (2007). Addressing immunization barriers, benefits, and risks. *Journal of Family Practice*, 56(3).

Kreuter, M. and Strecher, V. (1995). Changing inaccurate perceptions of health risk: Results from a randomized trial. *Health Psychology*, 14(1).

Lagarde, M., Haines, A., and Palmer, N. (2009). The impact of conditional cash transfers on health outcomes and use of health services in low and middle income countries. *Cochrane Database of Systematic*, 4(CD008137).

Meessen, B., Soucat, A., and Sekabaraga, C. (2011). Performance-based financing: just a donor fad or a catalyst towards comprehensive health-care reform? *Bulletin of the World Health Organization*, 89.

Middaugh, P. (1979). Side effects of diphtheria-tetanus toxoid in adults. *American Journal of Public Health*, 69.

Moran, W., Nelson, K., Wofford, J., Ramon, V., and Case, D. (1996). Increasing influenza immunization among high-risk patients: Education or financial incentive? *American Journal of Medicine*, 101(6).

Morris, S., Flores, R., Olinto, P., and Medina, J. (2004). Monetary incentives in primary health care and effects on use and coverage of preventive health care interventions in rural honduras: cluster randomised trial. *Lancet*, 9450(4).

Myerson, J. and Green, L. (1995). Discounting of delayed rewards. *Journal of the Experimental Analysis of Behavior*, 64.

Nichter, M. (1995). Vaccinations in the third world: A consideration of community demand. *Social Science and Medicine*, 41(5).

Nyhan, B., Reifler, J., and Richey, S. (2014). Effective messages in vaccine promotion: a randomized trial. *Pediatrics*, 133(4).

Ogunlesi, A. (2011). Vaccines for women to prevent neonatal tetanus: Rhl commentary. *The WHO Reproductive Health Library*.

O'Keefe, D. and Nan, X. (2012). The relative persuasiveness of gain- and loss-framed messages for promoting vaccination: A meta-analytic review. *Health Communication*, 27(8).

Okwaraji, B., Cousens, S., Berhane, Y., Mulholland, K., and Edmond, K. (2012). Effect of geographical access to health facilities on child mortality in rural Ethiopia: A community based cross sectional study. *PLoS ONE*, 7(3).

Onalo, R., Ishiaku, H., and Ogala, W. (2010). Prevalence and outcome of neonatal tetanus in Zaria, northwestern Nigeria. *Journal of Infect Dev Ctries*, 26(5).

Orimadegun, A., Adedayo, A., and Olusegun, A. (2014). Adolescent girls' understanding of tetanus infection and prevention: Implications for the disease control in western Nigeria. *Frontiers in Public Health*, 2.

Oruamabo, S. (2007). Neonatal tetanus in Nigeria: does it still pose a major threat to neonatal survival? *Archives of Disease in Childhood*, 92.

Pebley, A., Goldman, N., and Rodriguez, G. (1996). Prenatal and delivery care and childhood immunization in Guatemala: Do family and community matter? *Demography*, 33(2).

Petrosino, A., Turpin-Petrosino, C., Hollis-Peel, M., J., L., and Stern, A. (2004). Scared straight and other juvenile awareness programs for preventing juvenile delinquency. *J Crime Prevention Research Revie*.

Rachiotis, G., Mouchtouri, A., Kremastinou, J., Gourgoulianis, K., and Hadjichristodoulou, C. (2010). Low acceptance of vaccination against the 2009 pandemic influenza a(h1n1) among healthcare workers in Greece. *Euro Surveill*, 15(6).

Rachlin, H., Rainieri, A., and Cross, D. (1991). Subjective probability and delay. *Journal of the Experimental Analysis of Behavior*, 55.

Rainey, J., Watkins, M., Ryman, T., Sandhu, P., Bo, A., and Banerjee, K. (2011). Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: findings from a systematic review of the published literature, 1999-2009. *Vaccine*, 29(46).

Renne, E. (2006). Perspectives on polio and immunization in northern Nigeria. *Social Science and Medicine*, 63(7).

Robertson, L., Mushati, P., Eaton, W., Dumba, L., Mavise, G., Makoni, J., Schumache, C., Crea, T., Monasch, R., Sherr, L., Garnett, P., Nyamukapa, C., and Gregson, S. (2013). Effects of unconditional and conditional cash transfers on child health and development in Zimbabwe: a cluster-randomised trial. *Lancet,*, 381(9874).

Rothman, A. and Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychological Bulletin*, 121.

Rothman, A., Salovey, P., Antone, C., Keough, K., and Martin, C. (1993). The influence of message framing on intentions to perform health behaviors. *Journal of Experimental Social Psychology*, 29.

Salinas-Rodriguez, A. and Manrique-Espinoza, B. (2013). Effect of the conditional cash transfer program oportunidades on vaccination coverage in older Mexican people. *BMC International health and human rights*, 13(1).

Steele, F., Diamond, I., and Amin, S. (1996). Immunization uptake in rural Bangladesh: a Multilevel analysis. *Journal of the Royal Statistical Society*, A(159).

Sutherland, K., Leatherman, S., and Christianson, J. (2008). Paying the patient: does it work? A revew of patient-targeted incentives. *The Health Foundation*.

Thysen, S., Byberg, S., Pedersen, M., Rodrigues, A., Ravn, H., Martins, C., Benn, C., Aaby, P., and Fisker, A. (2014). BCG coverage and barriers to BCG vaccination in Guinea-Bissau: an observational study. *BMC Public Health*, 14(1).

Tumusiime, P., Gonani, A., Walker, O., Asbu, E., Awases, M., and Kariyo, P. (2012). Health systems in sub-saharan africa: What is their status and role in meeting the health millennium development goals? *The African Health Monitor*.

Umar, N., Hajara, M., and Khalifa, M. (2011). Reduction of client waiting time using task shifting in an anti-retroviral clinic at Specialist Hospital Bauchi, Nigeria. *Journal of Public Health in Africa*, 2(e2).

UNICEF (2001). Combatting antivaccination rumors: Lessons learned from case studies in east africa. *UNICEF*.

UNICEF (2010). Maternal and neonatal tetanus elimination initiative. *UNICEF*.

Weaver, T., Metrebia, N., Hellier, J., Pilling, S., Charles, V., Little, N., Poovendran, D., Mitcheson, L., Ryan, F., Bowden-Jones, O., Dunn, J., Glaspe, A., Finch, E., and Strang, J. (2014). Use of contingency management incentives to improve completion of hepatitis B vaccination in people undergoing treatment for heroin dependence: a cluster randomised trial. *Lancet*, 38(9938).

WHO (2006). Maternal immunization against tetanus. *WHO Standards for Maternal and Neonatal Care*.

WHO (2013). Weekly epidemiological record. *WHO*, 88.

WHO (2014). Weekly epidemiological record. *WHO*, 89.

Witte, K. (1994). Fear control and danger control: A test of the extended parallel process model. *Communication Monographs*, 61(2).

Witte, K. and Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education and Behavior*, 27(5).

Zwane, A. and Kremer, M. (2007). What works in fighting diarrheal diseases in developing countries? a critical review. *World Bank Research Observer*, 22(1).

Zziwa, G. (2009). Review of tetanus admissions to a rural Ugandan hospital. *Health Policy and Development*, 7(3).

Table 3.1: Randomization Check

	# of Obs	CCT5	CCT300	CCT800	Joint significance (p-value)
	(1)	(2)	(3)	(4)	(5)
Panel A: Peers					
# peers in 100 meters	2482	13.261	14.180	13.179	0.041
% peers offered CCT800 in 100 meters	2482	0.343	0.354	0.332	0.020
# friends listed and matched	2482	0.348	0.384	0.359	0.447
# friends offered CCT800	2482	0.101	0.128	0.121	0.207
Panel B: Respondent's characteristics					
Age	624	24.848	25.033	25.597	0.413
Highest education = no education	624	0.492	0.460	0.449	0.661
Not married	624	0.152	0.161	0.171	0.872
Muslim	624	0.416	0.464	0.444	0.618
Received tetanus vaccine before	624	0.462	0.384	0.384	0.185
Have paid work	624	0.442	0.393	0.458	0.375
Used clinic before	624	0.706	0.763	0.741	0.417
Distance to health clinic (km)	624	1.807	1.706	1.662	0.492
Have children	624	0.777	0.773	0.755	0.852
Pregnant	619	0.118	0.163	0.199	0.083
Earning per capita (naira)	624	5456.9	6524.9	6502.6	0.410
Distance to Clinic (less than 0.5km)	624	0.188	0.190	0.213	0.767
Distance to Clinic (0.5-1.5km)	624	0.254	0.275	0.278	0.839
Distance to Clinic (1.5-2.5km)	624	0.274	0.275	0.255	0.868
Distance to Clinic (more than 2.5km)	624	0.284	0.261	0.255	0.776
Respondent thinks vaccine has side effects	624	0.675	0.711	0.616	0.109
Panel C: Best friend's characteristics					
Best friend received CCT800	624	0.340	0.417	0.389	0.273
Best friend's age	624	25.234	25.289	25.012	0.880
Best friend = muslim	624	0.404	0.488	0.438	0.222
Best friend received no education	624	0.492	0.464	0.414	0.269
Distance to Best Friend (less than 25m)	624	0.249	0.242	0.255	0.953
Distance to Best Friend (25-55m)	624	0.223	0.270	0.245	0.549
Distance to Best Friend (55-135m)	624	0.254	0.270	0.241	0.785
Distance to Best Friend (more than 135m)	624	0.274	0.218	0.259	0.396
Best friend thinks vaccine has side effects	624	0.678	0.659	0.650	0.837

Notes: Sample used here is the total sample of 2,482 women in panel A, and the sample of 624 women who listed another respondent in the survey as a friend in Panel B and C. 150 naira = $1 approximately. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3.2: Effect of Social Networks

Specification:	OLS				IV			
Dependent variable:	Received vaccine							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# peers vaccinated in a village	0.017***				0.024***			
	(0.003)				(0.004)			
# peers vaccinated in 100 meters		0.044***				0.036***		
		(0.005)				(0.013)		
# friends vaccinated			0.109***				0.172*	
			(0.037)				(0.091)	
# friends vaccinated = 1				0.111***				0.168*
				(0.039)				(0.096)
# friends vaccinated = 2				0.208**				0.453**
				(0.080)				(0.185)
Observations	2482	2482	2482	2482	2482	2482	2482	2482
R-squared	0.263	0.281	0.352	0.352	0.255	0.278	0.350	0.348
Mean of dependent var	0.726	0.726	0.702	0.702	0.726	0.726	0.702	0.702
Covariates	X	X	X	X	X	X	X	X
Fixed effect by clinic (10 clinics)	X	X			X	X		
Fixed effect by village (80 clinics)			X	X			X	X

Notes: Sample used here is the main sample of 2,482 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). "# peers vaccinated in a village" represents the number of women in a village who received the tetanus vaccine excluding the respondent. "# peers vaccinated in 100 meters" represents the number of women within 100 meters from a respondent's house who received the tetanus vaccine. "# friends vaccinated" is the number of respondent's friends received tetanus vaccine. "Friends" are defined as someone whom each respondent listed in either one of 6 categories: a best friend, a friend whom they admire, a friend whom they talk about health issues with, a friend whom they go to health clinic together with, a friend whom they visit if she is sick, a friend who visits them when they are sick. The instrument used in IV regression for "# peers vaccinated in a village" is "# peers offered CCT800 in a village ". The instrument used in IV regression for "# peers vaccinated in 100 meters" is "# peers offered CCT800 in 100 meters". The instrument used in IV regression for "# friends vaccinated" is "# friends offered CCT800". Robust standard errors clustered by villages (80 villages) are presented. Covariates include own treatment status (Clinic CCT, Vaccine CCT & Fear, CCT300, CCT800), interaction term between Clinic CCT and each CCT dummy, and between Vaccine CCT & Fear and each CCT dummy, total number of respondents in the village in (1) and (5), total number respondents within 100 meters in (2) and (6), or total number of friends listed in (3) (4) (7) (8), age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. The average number of women in one village is 31.235. The average number of women in 100 meters is 13.547. The average number of friends one lists who were also in the study is 0.36. Conditioned on having at least 1 friend, the number of friends a respondents lists who were in the study is 1.15. Mean of Dependent Variable is overall mean in (1), (2), (5), (6), and mean if no friend received a vaccine in (3), (4), (7), and (8). * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3.3: Effect of Friends

Specification:	OLS			IV		
Dependent variable:	Received vaccine					
	(1)	(2)	(3)	(4)	(5)	(6)
Any friend received vaccine	0.099***	0.110**		0.114*	0.206*	
	(0.036)	(0.052)		(0.069)	(0.111)	
Best friend received vaccine			0.041			0.258*
			(0.054)			(0.142)
Constant	0.156	-0.587**	0.850**	-0.337	-1.440***	-0.247
	(0.159)	(0.284)	(0.395)	(0.283)	(0.531)	(0.420)
Observations	2482	775	624	2482	775	624
R-squared	0.349	0.421	0.403	0.349	0.416	0.376
Mean of dependent var among control	0.694	0.464	0.464	0.694	0.464	0.464
Covariates	X	X	X	X	X	X
Fixed effect by village (80)	X	X	X	X	X	X

Notes: Sample used in (1) & (4) is the total sample of 2,482 women who participated in the larger survey. Survey used in (2) & (5) is the sample of 775 women who listed some respondents who also participated in the survey as friends. Sample used in (3) & (6) is the sample of 624 women who listed another respondent in the survey as a best friend. Robust standard errors clustered by villages are presented. The instrument used in IV regression for "Any friend received vaccine" is "Any friend received CCT800", and the instrument for "Best friend received vaccine" is "Best friend received CCT800". Covariates include the total number of women who participated in the survey in a village, own treatment status (CCT300, CCT800), age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. 150 naira = $1 approximately. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3.4: Comparing Effect of Best Friends' Vaccination and CCT

Dependent variable:	Received vaccine
	(1)
Best friend received vaccine	0.336
	(0.310)
Best friend received vaccine * CCT300	-0.128
	(0.330)
Best friend received vaccine * CCT800	-0.177
	(0.301)
CCT300	0.281
	(0.258)
CCT800	0.385
	(0.243)
Constant	-0.248
	(0.422)
Observations	624
R-squared	0.429
Mean of dependent var among control	0.269
Covariates	X
Fixed effect by village (80)	X

Notes: Sample used here is the sample of 624 women who listed another respondent in the survey as a friend. Robust standard errors clustered by villages are presented. The instrument used in IV regression for "Best friend received vaccine" is "Best friend received CCT800". Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. 150 naira = $1 approximately. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3.5: Differential Effect of Friends - Distance

Dependent variable:	Received vaccine	
	(1)	(2)
Best friend received vaccine	0.023	0.626**
	(0.283)	(0.277)
Best friend received vaccine * Distance to clinic (0.5-1.5km)	0.143	
	(0.374)	
Best friend received vaccine * Distance to clinic (1.5-2.5km)	0.899*	
	(0.514)	
Best friend received vaccine * Distance to clinic (more than 2.5km)	0.105	
	(0.357)	
Distance to clinic (0.5-1.5km)	-0.134	
	(0.298)	
Distance to clinic (1.5-2.5km)	-0.736*	
	(0.433)	
Distance to clinic (more than 2.5km)	-0.230	
	(0.281)	
Best friend received vaccine * Distance to best friend (25-55m)		-0.136
		(0.438)
Best friend received vaccine * Distance to best friend (55-135m)		-0.523
		(0.358)
Best friend received vaccine * Distance to best friend (more than 135m)		-0.835**
		(0.358)
Distance to best friend (25-55m)		0.054
		(0.356)
Distance to best friend (55-135m)		0.413
		(0.300)
Distance to best friend (more than135m)		0.564*
		(0.290)
Constant	0.339	-0.578
	(0.418)	(0.393)
Observations	624	624
R-squared	0.066	0.391
Mean of dependent var among control	0.500	0.383
Covariates	X	X
Fixed effect by village (80)		X
p-values of F-test: Best friend received vaccine + (…….) = 0		
+ Best friend received vaccine * Distance to clinic (0.5-1.5km) = 0	0.441	
+ Best friend received vaccine * Distance to clinic (1.5-2.5km) = 0	0.051	
+ Best friend received vaccine * Distance to clinic (more than 2.5km) = 0	0.518	
+ Best friend received vaccine * Distance to best Friend (25-55m) = 0		0.123
+ Best friend received vaccine * Distance to best Friend (55-135m) = 0		0.624
+ Best friend received vaccine * Distance to best Friend (more than 135m) = 0		0.441

Notes: Sample used here is the sample of 624 women who listed another respondent in the survey as a friend. The threshold of the distance is defined as every 25% of the distribution. Robust standard errors clustered by villages are presented. The instrument used in IV regression for "Best friend received vaccine" is "Best friend received CCT800". Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 3.6: Differential Effect of Friends - Side effects

Dependent variable:	Received vaccine		
	(1)	(2)	(3)
Best friend received vaccine	0.495**	0.370*	0.807**
	(0.225)	(0.213)	(0.344)
Best friend received vaccine * (Respondent thinks vaccine has side effects)	-0.384		
	(0.258)		
Respondent thinks vaccine has side effects	0.310		
	(0.214)		
Best friend received vaccine * (Best friend thinks vaccine has side effects)		-0.222	
		(0.256)	
Best friend thinks vaccine has side effects		0.138	
		(0.200)	
Best friend received vaccine * (Respondent or best friend thinks vaccine has side effects)			-0.662*
			(0.351)
Respondent or best friend thinks vaccine has side effects			0.465
			(0.309)
Constant	-0.636	-0.329	-0.733
	(0.486)	(0.472)	(0.558)
Observations	624	624	624
R-squared	0.408	0.438	0.403
Mean of dependent var among control	0.522	0.500	0.493
Covariates	X	X	X
Fixed effect by village (80)	X	X	X
p-values of F-tes: Best friend received vaccine + (…….) = 0			
+ Best friend received vaccine * (Respondent thinks vaccine has side effects) = 0	0.513		
+ Best friend received vaccine * (Best friend thinks vaccine has side effects) = 0		0.389	
+ Best friend received vaccine * (Respondent or best friend thinks vaccine has side effects) = 0			0.334

Notes: Sample used here is the sample of 624 women who listed another respondent in the survey as a friend. Robust standard errors clustered by villages are presented. The instrument used in IV regression for "Best friend received vaccine" is "Best friend received CCT800". Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.1: Baseline Characteristics by Sample

	Total Sample (N=2482)	Sample with friends in the survey (N=624)	Difference (p-value)
	(1)	(2)	(3)
Age	25.108	25.170	0.821
Highest education = no education	0.483	0.466	0.455
Not married	0.153	0.162	0.574
Muslim	0.496	0.442	0.017
Received tetanus vaccine before	0.398	0.409	0.643
Have paid work	0.435	0.431	0.856
Used clinic before	0.722	0.737	0.460
Distance to health clinic (km)	1.718	1.723	0.937
Have children	0.765	0.768	0.878
Pregnant	0.182	0.162	0.242
Earning per capita (naira)	5875.511	6180.017	0.417

Notes: Sample used here is the total sample of 2,482 women in column (1), and the sample of 624 women who listed another respondent in the survey as a best friend in column (2). 150 naira = $1 approximately. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.2: Effect of Social Networks: First Stage

Dependent variables:	# peers vaccinated in a village	# peers vaccinated in 100 meters	# friends vaccinated
	(1)	(2)	(3)
# peers offered CCT800 in a village	2.292***		
	(0.503)		
# peers offered CCT800 in 100 meters		0.542***	
		(0.135)	
# friends offered CCT800			0.245***
			(0.032)
Observations	2482	2482	2482
R-squared	0.958	0.852	0.745
Mean of dependent var	36.956	9.947	0.268
Mean of independent var	16.988	4.604	0.149
Covariates	X	X	X
Fixed effect by clinic (10 clinics)	X	X	
Fixed effect by village (80 clinics)			X

Notes: Sample used here is the main sample of 2,482 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates)."# peers offered CCT800 in a village" represents the number of women in a village whowere offered CCT800. "# peers offered CCT800 in 100 meters" is the number of women in 100 meters from a respondents who were offered CCT800. "# friends offered CCT800" is the number of respondent's friends who were offered CCT800. "Friends" are defined as someone whom each respondent listed in either one of 6 categories: a best friend, a friend whom they admire, a friend whom they talk about health issues with, a friend whom they go to health clinic together with, a friend whom they visit they she is sick, a friend who visits them when they are sick. Robust standard errors clustered by villages (80 villages) are presented. Covariates include ClinicCCT, VaccineCCT&Fear, CCT300, CCT800, total number of respondents in the village in (1), total number of respondents within 100 meters in (2), or total number of friends listed in (3), age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. The average number of women in one village is 31.235. The average number of women in 100 meters is 13.547. The average number of friends one lists who were also in the study is 0.36. Conditioned on having at least 1 friend, the number of friends a respondents lists who were in the study is 1.15. Mean of Dependent Variable is the overall mean. Mean of Independent Variable is overall mean in (1) and (2), and mean if no friends received CCT800 in (3). * significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.3: Mechanism: Information Sharing

Dependent variables:	# of correct answers	Number of people who die of tetanus	Very worried about Tetanus	Tetanus is very bad	Very important to be protected from tetanus	Vaccine efficacy
Panel A: Village	(1)	(2)	(3)	(4)	(5)	(6)
% peers vaccinated in a village before one's intervention	0.053	-2.332	0.018	0.076**	0.030	1.129
	(0.090)	(1.595)	(0.029)	(0.034)	(0.040)	(1.669)
Observations	2460	2455	2460	2460	2460	2457
R-squared	0.026	0.011	0.043	0.025	0.028	0.014
Mean of dependent var	3.513	30.151	0.356	0.434	0.495	22.254
Covariates	X	X	X	X	X	X
Fixed effect by clinic (10 clinics)	X	X	X	X	X	X
Panel B: Neighborhood	(7)	(8)	(9)	(10)	(11)	(12)
% peers vaccinated in 100 meters before one's intervention	0.132	0.146	-0.016	-0.000	-0.007	3.171**
	(0.091)	(1.280)	(0.031)	(0.031)	(0.036)	(1.368)
Observations	2417	2412	2417	2417	2417	2414
R-squared	0.030	0.010	0.043	0.023	0.028	0.017
Mean of dependent var	3.513	30.151	0.356	0.434	0.495	22.254
Covariates	X	X	X	X	X	X
Fixed effect by clinic (10 clinics)	X	X	X	X	X	X
Panel C: Friends	(13)	(14)	(15)	(16)	(17)	(18)
Any friends vaccinated before one's intervention	0.206**	1.245	0.008	0.009	0.001	3.656**
	(0.079)	(1.244)	(0.031)	(0.037)	(0.030)	(1.786)
Observations	2460	2455	2460	2460	2460	2457
R-squared	0.028	0.013	0.043	0.028	0.032	0.019
Mean of dependent var	3.499	30.449	0.357	0.447	0.507	22.312
Covariates	X	X	X	X	X	X
Fixed effect by village (80 clinics)	X	X	X	X	X	X

Notes: Sample used here is the main sample of 2,482 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). % peers vaccinated in a village before one's intervention" represents the percentage of women in a village who received the tetanus vaccine before the respondent. "% peers vaccinated in 100 meters before one's intervention" represents the percentage of women within 100 meters from a respondent's house who received the tetanus vaccine after the respondent. "Any friends vaccinated before one's intervention" is the dummy variable which takes 1 if any of respondent's friends received tetanus vaccine before the respondent. "Friends" are defined as someone whom each respondent listed in either one of 6 categories: a best friend, a friend whom they admire, a friend whom they talk about health issues with, a friend whom they go to health clinic together with, a friend whom they visit if she is sick, a friend who visits them when they are sick. Robust standard errors clustered by villages (80 villages) are presented. The average number of women in one village is 31.235. The average number of women in 100 meters is 13.547. The average number of friends one lists who were also in the study is 0.36. Conditioned on having at least 1 friend, the number of friends a respondents lists who were in the study is 1.15. All the dependent variables indicate the measurement before the flipcharts intervention. "# of correct answers" counts the number of questions that the respondent answered correctly about tetanus. "Number of people who die of tetanus" is a number of people out of 100 a respondent provided to a question "Once they have Tetanus, how many people do you think would die because of Tetanus?". "Very worried about tetanus" is a binary variable which takes 1 if a respondent answers "very worried" to the question "How worried are you that you might get tetanus? Very worried, worried, not too worried, not worried at all?". "Tetanus is very bad" is a binary variable which takes 1 is a respondent answers "very bad" to the question "How bad would it be if you get tetanus? Very bad, bad, not too bad, not bad at all?". "Very important to be protected from tetanus" is a binary variable which takes 1 is a respondent answers "very important" to the question "How important is it for you to make sure that you are protected from tetanus? Very important, important, not too important, not important at all?" "Vaccine efficacy" is the difference between hypothetical number of unvaccinated people who get tetanus and number of vaccinated people who get tetanus. "Correct # of answers" is the number of answers about sympstoms and causes of tetanus.The total number of questions is 6. Covariates include own treatment status (Clinic CCT, Vaccine CCT & Fear, CCT300, CCT800), interaction term between Clinic CCT and each CCT dummy, and between Vaccine CCT & Fear and each CCT dummy, total number of respondents in the village in panela A, total number respondents within 100 meters in panel B, or total number of friends listed in panel C, age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. Mean of Dependent Variable is overall mean in (1) to (12), and mean if no friend received a vaccine in (13) to (18). * significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.4: Mechanism: Learning from Others' Vaccination

Dependent variable:	Received Vaccine		
	(1)	(2)	(3)
# peers vaccinated in a village before one's intervention	-0.002		
	(0.002)		
# peers vaccinated in 100 meters before one's intervention		0.003	
		(0.011)	
# friends vaccinated before one's intervention			0.244
			(0.358)
Observations	2482	2482	2482
R-squared	0.198	0.196	0.343
Mean of dependent var	0.682	0.699	0.725
Covariates	X	X	X
Fixed effect	X	X	X
Coefficient of first stage	4.290***	0.612***	0.076**
	(0.901)	(0.184)	(0.030)

Notes: Sample used here is the main sample of 2,482 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). "# peers vaccinated in a village before one's intervention" is number of women in a village who received a vaccine before one received an interview. "# peers vaccinated in 100 meters before one's intervention" is the number of neighbors who received a vaccine before one received an interview. "# friends vaccinated before one's intervention" is the number of friends who received a vaccine before one received an interview. Each of main independent variables was instrumented with number of peers in the social network who were interviewed before one's interview and offered CCT800. Robust standard errors clustered by villages (80 villages) are presented. Covariates include ClinicCCT, VaccineCCT&Fear, CCT300, CCT800, and interaction between each treatment, age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. Mean of Dependent Variable is mean if no peers received vaccine before. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.5: Mechanism: Cost Sharing

Dependent variable:	Received Vaccine	
	(1)	(2)
Total CCT among neighbors	-0.001	
	(0.001)	
Total CCT among friends		0.002
		(0.003)
Observations	2482	2482
R-squared	0.109	0.115
Mean of Dependent Variable	0.726	0.726
Covariates	X	X
Fixed effect by village (80 villages)	X	X

Notes: Sample used here is the main sample of 2,482 women whose household location is recorded with GPS coordinates (8 have a missing value on GPS coordinates). Because coefficients are very small, the table shows the coefficients * 100. "Total CCT among neighbors" represents the total amount of CCT that neighbors of a respondent were offered in 100 meters. "Total CCT among friends" represents the total amount of CCT that friends of a respondent were offered. The number does not include the amount that a respondent was offered. "Friends" are defined as someone whom each respondent listed in either one of 6 categories: a best friend, a friend whom they admire, a friend whom they talk about health issues with, a friend whom they go to health clinic together with, a friend whom they visit they she is sick, a friend who visits them when they are sick. Robust standard errors clustered by villages (80 villages) are presented. Covariates include CCT300, CCT800, total number of respondents within 100 meters in (1), or total number of friends listed in (2), age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. Mean of Dependent Variable is overall mean. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.6: Distance and Clinic Attendance with Friends

Dependent variable:	Visited Clinic with Friends	
	(1)	(2)
Distance to clinic (0.5-1.5km)	0.159**	
	(0.072)	
Distance to clinic (1.5-2.5km)	0.151	
	(0.150)	
Distance to clinic (more than 2.5km)	-0.011	
	(0.133)	
Distance to best friend (25-55m)		-0.166***
		(0.062)
Distance to best friend (55-135m)		-0.232***
		(0.071)
Distance to best friend (more than 135m)		-0.256***
		(0.048)
Constant	0.462	0.817**
	(0.366)	(0.369)
Observations	624	624
R-squared	0.064	0.107
Mean of dependent var among control	0.080	0.419
Covariates	X	X
Fixed effect by village (80)	X	X

Notes: Sample used here is the sample of 624 women who listed another respondent in the survey as a friend. Robust standard errors clustered by villages are presented. The dependent variable "Visited Clinic with Friends" is a dummy variable which takes 1 if the respondent had a follow-up survey at the health clinic within 20 minutes from when her friend had a follow-up survey at the same health clinic.The threshold of the distance is defined as every 25% of the distribution. Covariates include own treatment status (CCT300, CCT800), age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A3.7: Correlation of Belief among Friends

Dependent variable:	Respondent thinks vaccine has side effects
	(1)
Best friend thinks vaccine has side effects	0.358***
	(0.078)
Best friend thinks vaccine has side effects * Distance to best friend (25-55m)	-0.263**
	(0.109)
Best friend thinks vaccine has side effects * Distance to best friend (55-135m)	-0.255**
	(0.110)
Best friend thinks vaccine has side effects * Distance to best friend (more than 135m)	-0.315***
	(0.109)
Distance to best friend (25-55m)	0.156*
	(0.089)
Distance to best friend (55-135m)	0.126
	(0.090)
Distance to best friend (more than 135m)	0.171*
	(0.088)
Constant	0.504
	(0.397)
Observations	624
R-squared	0.127
Mean of dependent var among control	0.509
Covariates	X

Notes: Sample used here is the sample of 624 women who listed another respondent in the survey as a friend. The threshold of the distance is defined as every 25% of the distribution. Robust standard errors clustered by villages are presented. Covariates include age, education level, marital status, religion, if received tetanus vaccine before, if has paid work, if ever used the clinic before, and distance to the clinic. * significant at 10%; ** significant at 5%; *** significant at 1%