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Increasing Second-dose HPV Vaccination in Bogota, Colombia

Déborah Martínez Villarreal
Lina Díaz
Stanislao Maldonado

Inter-American Development Bank
Department of Research and Chief Economist

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Déborah Martínez Villarreal*
Lina Díaz*
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* Inter-American Development Bank
** Universidad del Rosario

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Abstract[1]

This study investigates the effectiveness of dynamic norm nudges in promoting second-dose HPV vaccinations among *trendsetters*—parents who initiated the first-dose HPV vaccine for their daughters between 2017-2020. Utilizing administrative data from Bogota's Secretariat of Health in a field experiment, we measure the impact of various norm nudges, including trending, qualitative, and quantitative dynamic norms, on actual vaccination rates. Contrary to our hypothesis, dynamic norms alone fail to influence second-dose HPV vaccination rates for these trendsetters. However, the study reveals a 5.22 percent increase attributed to injunctive norms, representing a substantial 34 percent boost compared to the control group's 15.2 percent average. These findings underscore the importance of tailoring nudge strategies to the unique characteristics and preferences of the target population. This research significantly advances our understanding of norm-based interventions' efficacy in influencing minority behaviors, offering valuable insights for developing targeted and impactful public health strategies.

JEL classifications: C93, D91, I10, I12, I15, I18
Keywords: Nudge, Behavioral economics, Health, Vaccination, HPV, Field experiment, Social norms, Trendsetters

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1. Introduction

Findings from an experiment on first-dose HPV vaccinations (Martínez Villarreal, 2023) indicate that dynamic norm nudges increase vaccine uptake among girls and adolescents in Bogota, Colombia, where only a minority of the population is vaccinated against HPV. In such a context, first-dose HPV vaccinations are considered a minority behavior. Since 2016, the World Health Organization health guidelines have recommended two doses of the HPV vaccine for coverage against cervical cancer (WHO, 2022),[2] but first-dose and second-dose HPV vaccination have been a minority behavior in Bogota since 2016. In this study, we test the hypothesis that dynamic norm nudges increase second-dose HPV vaccinations for trendsetters. We employ Bicchieri and Funcke's (2018) definition of trendsetters, i.e., as the initiators of norm abandonment. Norm abandonment occurs when societies replace one social norm for another (Andreoni et al., 2021; Bicchieri, 2017). In this context, trendsetters are the group of parents who vaccinated their daughters with the first-dose HPV vaccine between 2017 and 2020.

This is the first study that tests dynamic norm nudges' effect on trendsetters' behavior. We conducted a field experiment in Bogota, Colombia, to test our hypothesis. The experiment consists of text messages to parents of daughters 9-12 years old who have received the first-dose HPV vaccine but not the second. The experiment studies the effect of five norm nudge treatments. Three treatments are dynamic norms, one treatment is a descriptive norm, and another treatment is an injunctive norm. This experiment has one control group, one experimental control, and one policy control. Administrative records on vaccination from Bogota's Secretary of Health allow us to measure the effect of norm nudges on actual HPV vaccinations.

The literature most closely related to this study is studies of the effect of dynamic norm nudges on minority behaviors (Aldoh et al., 2021; Cheng et al., 2022; Mortensen et al., 2017; Loschelder et al., 2019; Sparkman and Walton, 2017; Milkman et al., 2022). In these studies, dynamic norm nudges inform experimental participants how other people's behavior has changed, or is changing, over time (Sparkman and Walton, 2017). The literature also tests different variations of dynamic norms, such as framings that either include or exclude elements like the percentage change in adopting the minority behavior. For example, Mortensen et al. (2017) and

[2] Recent studies demonstrate that a single dose of the HPV vaccine is sufficient to provide the same protection as a multidose regimen against HPV (WHO, 2022). However, when the experiment was conducted, the two-dose vaccine schedule was still the public health recommendation in Bogota. Starting September 30, 2023, Colombia has started a single-dose schedule countrywide, except for immunocompromised people.

Sparkman and Walton (2017) study the framings of dynamic norm nudges, which is also a focus of this study. This approach helps to determine which dynamic norm nudge has the largest effect on changing minority behaviors.

We test the effect of three framings based on the seminal work by Mortensen et al. (2017) and Sparkman and Walton (2017). In the first treatment, the trending norm contains information about the percentage change in the adoption of the minority behavior by the reference population: "Since 2016, the number of parents in your town who got the second dose of the HPV vaccine for their daughters has increased by 83 percent." In the second treatment, the qualitative dynamic norm communicates the trend in HPV vaccinations without mentioning the percentage change: "More and more parents in your area are giving their daughters their second dose of the HPV vaccine." In the third treatment, the quantitative dynamic norm adds the descriptive norm, which communicates the prevalence of the minority behavior, to the qualitative dynamic norm message: "Eight percent of parents in your area have already gotten the second dose of the HPV vaccine for their daughters, and more and more are doing it." The messages in each treatment refer to an increase in the trend of second-dose HPV vaccinations.

In addition to the research on the effects of dynamic norms on increasing minority behaviors, this paper draws on several other strands of literature. One of these strands is the research on trendsetters' behaviors (Bicchieri, 2017; Bicchieri and Funcke, 2018). Trendsetters have also been called positive deviants in the health literature (Herington and van de Fliert, 2018). Spreitzer and Sonenshein (2003) define positive deviants as individuals or groups that depart from the norms of a reference group in honorable ways. The research on positive deviants informs the design of interventions for behavioral change (Herington and van de Fliert, 2018; Bicchieri, 2017). For example, Pascale, Sternin and Sternin (2010) decreased children's malnutrition in Vietnam by applying the strategies of mothers who belonged to the minority and did not have malnourished children in the community.[3] Pascale, Sternin and Sternin (2010) refer to mothers who belong to the minority as positive deviants. Unlike studies such as theirs, however, this study focuses on an intervention directed at trendsetters.

[3] The strategies applied by these mothers go against locally accepted wisdom. Some of these strategies are feeding children even when they have diarrhea; feeding children several smaller meals rather than one or two large ones; and adding to children's rice foods that are associated with low socioeconomic status (Pascale, Sternin and Sternin, 2010).

Contrary to our hypothesis, the results indicate that dynamic norms do not increase second-dose HPV vaccination rates of trendsetters. This is also the case for the descriptive norm. Only the quantitative dynamic norm has a marginal statistically significant effect compared to the control group at the 90 percent confidence level. This is a surprising result since dynamic norms effectively increase minority behaviors in other contexts (Aldoh et al., 2021; Cheng et al., 2022; Mortensen et al., 2017; Loschelder et al., 2019; Sparkman and Walton, 2017; Milkman et al., 2022). The injunctive norm has a statistically significant increase in second-dose HPV vaccinations of 5.22 percent compared to the control average of 15.2 percent. This difference is equivalent to a 34 percent difference at a 99 percent confidence level.

The most effective message for increasing second-dose HPV vaccination is the experimental control. The experimental control is a personalized reminder signed by the Secretariat of Health of the following form: "Hi [Name of the parent]. Get your daughter the second dose of the HPV vaccine: give her all the protection. Secretariat of Health." Its effect represents a statistically significant increase of 50 percent compared to the control group.

2. Vaccination Context

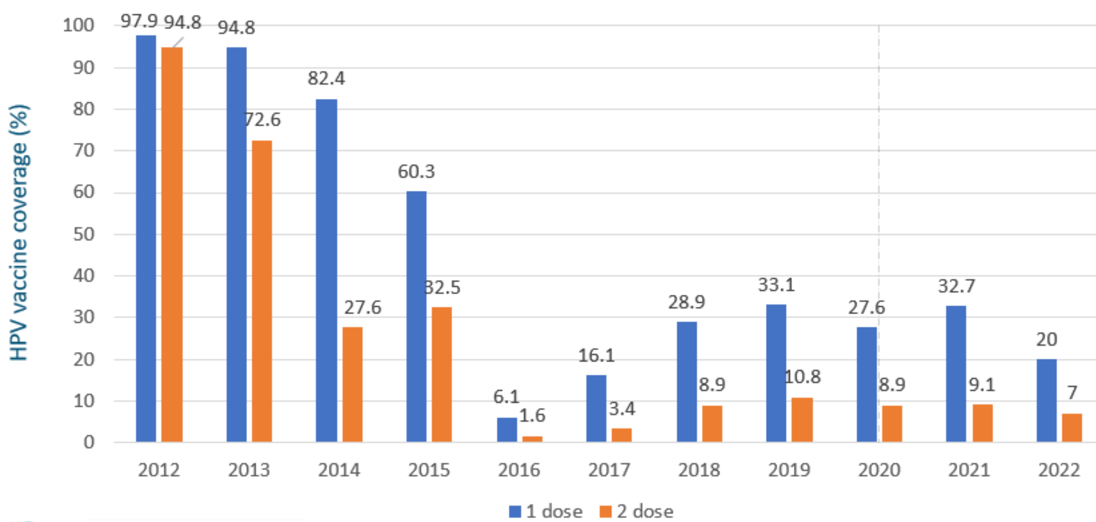
Cervical cancer (CC) is the fourth most common cancer in women worldwide, and it is one of the three most frequent cancers in women younger than 45 (D'Oria et al., 2022). Almost all cervical cancers are caused by the human papillomavirus, or HPV (Walboomers et al., 1999). In addition to CC, HPV is associated with oropharyngeal, anus, genitals, head, and neck cancer. Estimates show that 75 percent of women and men who are sexually active will acquire HPV in their lifetime (Mavundza et al., 2021). Fortunately, the risk of HPV infection and the development of CC can be significantly reduced through a set of HPV vaccines (WHO, 2017).

According to the Colombian Ministry of Health, CC is the leading cause of death from cancer in Colombia's women aged 30 to 59. In 2020, new CC cases represented 7.9 percent of all cancer cases, equivalent to 4,742 cases in that year (Córdoba-Sánchez et al., 2022). In this country, the risk of HPV infection can be reduced with two HPV vaccines administered through the Expanded Program on Immunization (PAI). The country's health system allows citizens to be vaccinated at any vaccination point regardless of their health provider. These vaccines are free for girls between 9 and 17. The Expanded Immunization Program of Colombia's Ministry of Health and Social Protection prioritizes 9-year-old girls' HPV vaccinations.

In 2012, Colombia was one of the leaders in HPV vaccination coverage in Latin America (Córdoba-Sánchez et al., 2022). After the initial introduction of the vaccine in 2012, it became recommended by the health authority and was administered in schools. However, the success of the country's vaccination program stopped after an outbreak of unknown etiology in the municipality of Carmen de Bolivar. Although safety studies found no association between the HPV vaccine and Carmen de Bolivar's events, vaccine coverage rates began to decline steadily, reaching their lowest point in 2016 (Córdoba-Sánchez et al., 2022).

Coverage levels of HPV vaccination have been recovering over the past years but are still far from the pre-Carmen de Bolivar levels. Figure 1 shows the vaccination rate of the first and second doses of the HPV vaccine for 9-year-old girls in Colombia. The second-dose vaccination rate is substantially lower than the first dose.

Figure 1. HPV Vaccination Rates in Colombia since the Introduction of the Vaccine in 2012



Source: Authors' compilation based on data from the Information System of the Expanded Immunization Program (PAI) of the Ministry of Health and Social Protection of Colombia.

Through a large text message communications campaign, we tested the impact of several behavioral economics principles on first and second-dose HPV vaccinations. To provide recommendations to increase HPV vaccination rates, we partnered with the Health Secretariat of Bogota, Colombia, La Liga Colombiana Contra el Cáncer, and the American Cancer Society to run six experiments.

This centralized information system of the Secretariat of Health (SH) was instrumental in evaluating the effectiveness of our interventions. Due to the current institutional framework in Colombia, health providers report data to the SH about all eligible individuals for vaccination. These include information about the administration of recommended vaccines by the country's health authorities. Moreover, the Secretariat of Health's technological capacities and vaccination efforts informed the selection of the text message campaign as the channel for this experiment. The SH had run text message campaigns to increase the administration of some vaccines, but not HPV vaccinations.

This study was pre-registered on January 21, 2022, at the American Economic Association's registry for randomized controlled trials.[4] The project was approved by the IRB of the University of Rosario in Colombia on October 6, 2020, under the name "Innovaciones conductuales para incrementar la tasa de vacunación contra el virus del papiloma humano en Bogotá, Colombia" (memorandum letter of approval available upon request from the authors).

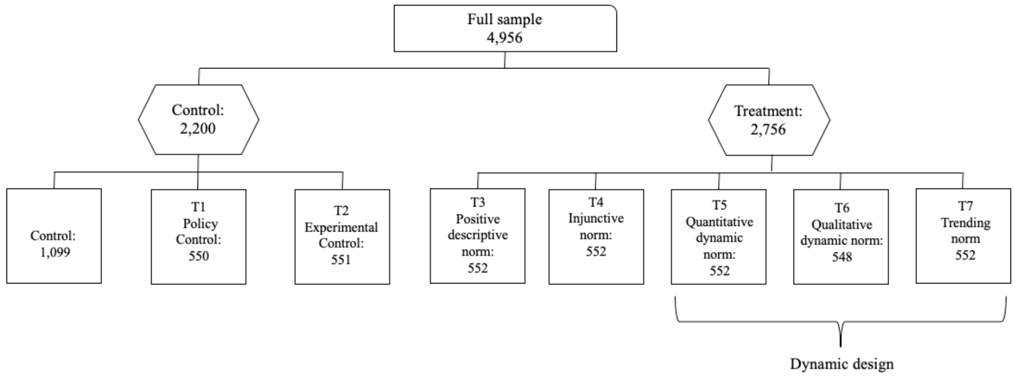
3. Experimental Design

This field experiment exploits alternative ways to communicate social norms through text messages to increase second-dose HPV vaccinations in parents with daughters 9-12 yrs. In this experiment, we test five norm nudge treatments, three containing dynamic norms, one containing a descriptive norm, and one containing an injunctive norm. The control group was divided into one experimental control, one policy control, and a pure control group that did not receive a message. Figure 2 depicts the experimental design with the corresponding sample size for each group. The effectiveness of each treatment was measured on actual HPV vaccinations thanks to the administrative data from the Secretariat of Health in Bogota.

The sample size for this experiment with unvaccinated girls is 4,956. The sample size by treatment arm is around 552 observations, and the control has 1,099 observations. The power calculations indicate a 4.14 percent minimum detectable effect based on the sample size and a 7 percent base rate. The base rate was an average of the past seven years' second-dose HPV vaccination rate. The power calculation is based on differences in proportions (Chi2 test), assuming 80 percent power and a 5 percent significance level.

[4] A detailed description of our protocol can be accessed here: www.socialscienceregistry.org/trials/8543.

Figure 2. Experimental Groups



Note: See Figure 3A for a representation of the full sample described in our registered protocol at the AEA.

The experiment consists of sending weekly norm nudges to the target population's parents over eight weeks through an online platform between October 21-December 14, 2021. This intervention is implemented within the regular communication policy of the Secretariat of Health. The content of the message remains constant throughout the weeks. Table A1 in the Appendix describes the messages delivered during this intervention. As an example, a subset of parents in this experiment receives a text message with a descriptive social norm (T3) of the following form: "Hello [Name of parent]. 8 percent of parents in your area have already gotten the second dose of the HPV vaccine for their daughters. Secretariat of Health."

The control group does not receive any messages. The policy control group receives the "business as usual" message that the Secretariat of Health of Bogota had used in previous public health campaigns. The experimental control group receives a placebo message. All norm nudges and the placebo message include two fixed elements found effective in other settings: the name of the recipient and the sender's information, in this case, "Secretariat of Health" (Constantino et al., 2021; Bursztyn et al., 2020). The policy message is not personalized or signed by the SH.

The target population for this intervention consists of parents with daughters ages 9-12 pending the second vaccine against HPV. The parents' administrative records are pulled based on records of girls between 9-12 years who had the first-dose HPV vaccine but were pending the second. The inclusion criteria are Bogota residency, the record of at least one parent, and a valid cellphone number of the parent. Moreover, because the experiments are block-randomized based on locality[5] and girls' age, we do not include observations from neighbor localities outside Bogota or records without information regarding their locality. We also dropped records from Sumapaz, the only rural locality in Bogota, with only 41 observations.

We designed the experiment to test the following seven hypotheses, corresponding to the groups T1-T7 in Figure 2.

3.1 Social Norms (T3 – T7)

H1: Norm nudges do not increase second-dose vaccinations for trendsetters.

Bicchieri and Dimant (2022) suggest that the effect of norm nudges depends on the target population's underlying beliefs. Frequently, heterogeneous analyses on the effect of norm nudges find unintended consequences on specific populations (Allcott, 2011; Beshears et al., 2015; Bicchieri and Dimant, 2022; Castro and Scartascini, 2015; Fellner et al., 2013; Ferraro et al., 2011; Kantorowicz-Reznichenko, 2021; Peth, 2018; Richter et al., 2018; Schultz et al., 2007). This is what Schultz et al. (2007) coined the boomerang effect.

Boomerang effects occur when the sub-population that already exhibits a behavior receives a descriptive norm nudge designed to affect that behavior. For example, Schultz et al. (2007) and Allcott (2011) find that households that consume less energy than their neighbors increase their consumption after receiving a descriptive norm nudge that makes this difference in energy consumption salient. Beshears et al. (2015) find that providing information about average savings decreases savings disproportionally among lower-income workers, as compared to other income brackets, in a work setting. Castro and Scartascini (2015) find that descriptive norms that communicate current levels of tax evasion increase tax compliance among previous non-compliers but decrease compliance among previously compliant taxpayers.

Moreover, norm nudge interventions frequently show null effects on behaviors (Dimant et al., 2020; Dur et al., 2021; Gravert et al., 2021; Silva et al., 2017; Venema et al., 2020). For example, Dur et al. (2021) test the effect of norm nudges on savings behavior and find no effects in the general target population or subsamples. Bicchieri and Dimant (2022) suggest that such null effects can occur when populations have preferences that are independent of social norms. As Bicchieri and Mercier (2014) explain, behaviors like brushing one's teeth are independent of social norms since an individual's decision to brush their teeth is not conditional on the perception of the

[5] Bogotá is subdivided administratively into 20 localities that group several neighborhoods.

popularity of this behavior. Therefore, nudging such behavior with social information would likely be ineffective (Bicchieri and Dimant, 2022).

The target population of this study, the *trendsetters*, allows us to test the effect of the social norms nudges on a population with underlying characteristics where boomerang effects or null effects are expected. The trendsetters already engaged in the minority behavior by getting their daughters their first-dose HPV vaccine. This behavior might indicate that trendsetters have HPV vaccination preferences independent of social norms. Our first hypothesis tests the effect of norm nudges on second-dose HPV vaccination for trendsetters.

3.2 Positive Descriptive Norm (T3)

H2: Descriptive norms do not increase second-dose vaccinations for trendsetters.

Norm nudges typically include either descriptive norms, injunctive norms, or both to elicit or change social expectations to impact the adoption of a behavior. Bicchieri and Xiao (2009) find that descriptive norms are the primary driving force behind social norm conformity. In this scenario where the norm is a minority behavior, the descriptive norms treatment reads, "8 percent of parents in your area have already gotten the second dose of the HPV vaccine for their daughters." Our second hypothesis tests whether descriptive norms increase second-dose HPV vaccination for trendsetters. A nudge containing only a descriptive message with the minority behavior will likely entrench the status quo (Bicchieri and Xiao, 2009; Bicchieri and Dimant, 2022; Kuang et al., 2020). However, it is not clear if this finding applies to trendsetters.

3.3 Injunctive Norm (T4)

H3: Injunctive norms increase second-dose HPV vaccinations for trendsetters.

Research finds that including injunctive norms prevents adverse outcomes of descriptive norms (Allcott, 2011; Bonan et al., 2020; Jachimowicz et al., 2018; Ryo et al., 2021; Schultz et al., 2007). Jacobson et al. (2022) suggest that injunctive norms trigger self-reflection and effortful self-regulation that might compensate for the automatic perception of descriptive norms. For example, in Schultz et al. (2007) and Allcott (2011), injunctive norms dissuade clients from consuming more energy when learning that their neighbors consume more energy than them. It is common to use a smiley face (or frowning face) emoticon to communicate the injunctive norm (Allcott, 2011; Bhanot, 2021; Schultz, 2007). The injunctive norm in this paper adds a smiley face to the descriptive norm in the following way, “8 percent of parents in your area have already gotten the second dose of the HPV vaccine for their daughters. You still have not :(.”

The assumption is that trendsetters' vaccination behavior falls under what Bicchieri and Dimant (2022) call independent behaviors. Independent behaviors are preferred either because they meet someone’s needs or because of moral convictions (Bicchieri and Dimant, 2022). If that is the case, then injunctive norms would address the underlying motivations of this population and are likely to increase second-dose HPV vaccinations.

3.4 Dynamic Norms (T5 – T7)

H4: Dynamic norms increase second-dose HPV vaccinations for trendsetters.

Many studies find that norm nudges based on dynamic norms increase the adoption of minority behaviors (Aldon et al., 2021; Cheng et al., 2022; Mortensen et al., 2017; Loschelder et al., 2019; Sparkman and Walton, 2017; Milkman et al., 2022). Dynamic norms are mainly effective in environmental minority behaviors (Constantino et al., 2022). Nyborg et al. (2016) suggest that the adoption mechanism relies on individuals’ anticipation of the behavior becoming a social norm in the future.

The literature loosely defines dynamic norms as social information communicating how other people’s behavior changes over time (Sparkman and Walton, 2017). Studies that test dynamic norms refer to them by various names, such as trending (Mortensen et al., 2017) or growing norms (Milkman et al., 2022). The application of dynamic norms in the literature is not consistent across studies. Therefore, we first test the effect of dynamic norms, loosely defined, on the increase of the minority behavior of second-dose HPV vaccinations for trendsetters.

3.5 Trending Norm (T7)

H5: Trending norms, informing subjects of population-wide increase in HPV vaccinations as a percentage change, increase second-dose HPV vaccinations for trendsetters.

To identify the elements that make dynamic norms effective, we test the effect of three dynamic norm treatments on second-dose HPV vaccinations for trendsetters based on the seminal work by Mortensen et al. (2017) and Sparkman and Walton (2017). The first treatment, the trending norm, follows the structure of Mortensen et al. (2017). In that study, Mortensen et al. (2017) define trending norms as the increasing number of people engaging in a behavior. For example, the trending norm treatment in that study reads as "In July, [previous year], 48 percent of the MTurk workers who took our surveys donated funds to the SEAA. This increased from 17 percent in July (2 years previous)." Unlike Mortensen et al. (2017), we do not communicate the descriptive minority behavior in this study. As seen in Table A1, the trending norm in the present study reads, "Since 2016, the number of parents in your town who got the second dose of the HPV vaccine for their daughters has increased by 83 percent."

3.6 Qualitative Dynamic Norm (T6)

H6: Qualitative dynamic norms, informing the trend in HPV vaccinations without alluding to the percentage change, increase second-dose HPV vaccinations for trendsetters.

The qualitative dynamic norm communicates the trend in HPV vaccinations without alluding to the percentage change based on Sparkman and Walton (2017). Sparkman and Walton (2017) find that experimental subjects' behavior is sensitive to social information of an upward change in collective behavior without communicating the number of people who have engaged in this behavior. For example, Sparkman and Walton (2017) test the following dynamic norm treatment: "Stanford Residents Are Changing: Now Most Use Full Loads! Help Stanford Conserve Water!" This study communicates the qualitative dynamic norm to trendsetters: "More and more parents in your area are giving their daughters their second dose of the HPV vaccine." As the trending norm, this version of the dynamic norm does not communicate the descriptive norms of the minority behavior. We test the hypothesis that qualitative dynamic norms increase second-dose HPV vaccinations for trendsetters.

3.7 Quantitative Dynamic Norm (T5)

H7: Quantitative dynamic norms, including the minority behavior of an eight percent second-dose HPV vaccination rate, increase second-dose HPV vaccinations for trendsetters.

Lastly, we test a dynamic norm that includes the minority behavior of an eight percent second-dose HPV vaccination rate, additionally to qualitatively communicate an increase in the popularity of the behavior. We call this treatment the quantitative dynamic norm, which reads the following way: "Eight percent of parents in your area have already gotten the second dose of the HPV vaccine for their daughters, and more and more are doing it." This treatment is influenced by the mix of elements seen in the dynamic norm nudge literature, such as Milkman et al. (2022). In that study, Milkman et al. (2022) refer to the dynamic norm as growing norm. The growing norm reads the following way: "More Americans are getting the flu shot than ever in the last decade. Last year, 45 percent of American adults got one." Previous studies find dynamic norms to be effective at increasing minority behavior despite informing subjects about the minority behavior (Mortensen et al., 2017; Sparkman and Walton, 2017; Milkman et al., 2022).

4. Empirical Analysis

4.1 Sample Characteristics and Balance Across Groups

Table A2 in the Appendix shows the descriptive statistics of available variables in the database, and Table A3 shows that treatments are balanced on the observable characteristics of the sample, the t-tests in this table compare each treatment to the control. Out of 84 comparisons, only three differences are statistically significant at the 95 percent confidence level. The differences are equivalent to less than 2 percent of the comparisons. EPS (name of an insurance provider), contributory insurance, uninsured, subsidized insurance, ethnic group, displaced by the armed conflict, Colombian nationality, and low stratum are binary variables. The low stratum is also binary and is constructed by grouping the two lowest neighborhood levels that the government of Bogota uses to characterize low socioeconomic status.

4.2 Regression Model

The impact evaluation is based on a standard intention-to-treat analysis (ITT). The main outcome variable is a binary measure of whether a parent's daughter gets vaccinated with a second-dose HPV vaccine during the text message campaign window or within three months after the campaign ends. The software we use to send text messages does not allow us to identify who receives or reads the messages. Thus, a treatment-on-the-treated (TOT) analysis is not possible.

We estimate three models. The first is

$$y_i = \alpha + \beta_1 T_{1i} + \beta_2 T_{2i} + \beta_3 T_{3-7i} + \gamma X_i + \theta_s + \mu_i \quad (1)$$

where y_i is the value of a dependent variable that indicates if the daughter of parent i gets vaccinated with the second-dose HPV vaccine (0 = daughter does not get vaccinated, 1 = daughter gets vaccinated). T_1 is an indicator variable taking the value of 1 when i is assigned to the policy control, and T_2 is an indicator variable taking the value of 1 when i is assigned to the experimental control. T_{3-7} is an indicator variable taking the value of 1 when i is assigned to a norm nudge. The reference group for this estimation is the control group. X is a vector of controls that includes all observable characteristics available in the administrative database: insurance company, type of insurance, ethnic group, displaced by the armed conflict, Colombian nationality, and a variable identifying whether the family lives in a low-income area (low stratum). θ_s is a vector of randomization strata dummy variables (locality*age), and μ_i is the error term.

The second model is

$$y_i = \alpha + \beta_1 T_{1i} + \beta_2 T_{2i} + \beta_3 T_{3i} + \beta_4 T_{4i} + \beta_5 T_{5-7i} + \gamma X_i + \theta_s + \mu_i \qquad (2)$$

where y_i is the value of a dependent variable that indicates if the daughter of parent i gets vaccinated with the second-dose HPV vaccine (0 = daughter does not get vaccinated, 1 = daughter gets vaccinated). T_1 is an indicator variable taking the value of 1 when i is assigned to the policy control. T_2, T_3, and T_4 take the value of 1 when i is assigned to the experimental control, descriptive norm, and injunctive norm treatments, respectively. T_{5-7} is an indicator variable taking the value of 1 when i is assigned to a norm nudge. The reference group for this estimation is the control group. X is a vector of controls that includes all observable characteristics available in the administrative database: insurance company, type of insurance, ethnic group, displaced by the armed conflict, Colombian nationality, and a variable identifying whether the family lives in a low-income area (low stratum). θ_s is a vector of randomization strata dummy variables (locality*age), and μ_i is the error term.

The third and final model is

$$y_i = \alpha + \beta_j T_j + \gamma X_i + \theta_s + v_i \qquad (3)$$

Similarly to the previous equations, y_i is the value of a dependent variable that indicates if the daughter of parent i gets vaccinated with the second-dose HPV vaccine (0 = daughter does not get vaccinated, 1 = daughter gets vaccinated), and T_j are indicator variables for i's treatment assignments j=1-7. In this case, the coefficients β_{j} estimate the average treatment effects of treatment j compared to the reference control group. X is the same vector of controls in equation 1 that includes all observable characteristics available in the administrative database, θ_s is a vector of randomization strata dummy variables (locality*age), and v_i is the error term.

5. Results

Table 1 presents the results of equations (1)-(3) that show the effect of norm nudges on increasing the second-dose HPV vaccinations for *trendsetters*.[6] Columns (1), (3), and (5) display the OLS estimates without controls, and columns (2), (4), and (6) show the OLS estimates controlling for relevant covariates. The control variables include insurance provider, type of insurance, ethnic group, displaced by armed forces, Colombian nationality, and low socioeconomic stratum. All the controls are dummy variables. The average vaccination rate in the control group during the experimental period was 15.2 percent.

Column one of Table 1 shows that the average second-dose HPV vaccination rate of girls whose parents received a norm nudge treatment is 2.8 percent higher than the control group's average. This result is statistically significant at a 95 percent confidence level. Column two shows that this result is robust when we control for covariates. This estimate is equivalent to an 18.4 percent difference between norm nudges and the control group. This result does not support H1, which states that norm nudges do not increase second-dose HPV vaccination rates for trendsetters. However, norm nudges include descriptive, injunctive, and dynamic norms. The subsequent analysis will allow us to identify what elements of norm nudges impact this population.

[6] This study focuses on the pure effect of social norms on trendsetters, which requires restricting the original sample, depicted in Figure 3A in the Appendix. All the results presented here exclude the sample of parents of daughters 13-17 years old to focus on the *trendsetters* and exclude the parents who received a follow-up message after each weekly message that served as a planning tool. Columns one and two in Table A5 in the Appendix show results for the whole sample. Columns two and three show the effect of the planning tool on the whole sample, while columns four and five show the effect of the planning tool on the *trendsetters*.

Table 1. There is no evidence that dynamic norms effectively increase second-dose HPV vaccinations for trendsetters

VARIABLES	(1) OLS **Applied vaccine**	(2) OLS **Applied vaccine**	(3) OLS **Applied vaccine**	(4) OLS **Applied vaccine**	(5) OLS **Applied vaccine**	(6) OLS **Applied vaccine**
Policy control	-0.0120	-0.0109	-0.0120	-0.0109	-0.0120	-0.0109
	(0.0198)	(0.0198)	(0.0198)	(0.0198)	(0.0198)	(0.0198)
Experimental control	0.0749***	0.0760***	0.0749***	0.0760***	0.0749***	0.0760***
	(0.0198)	(0.0198)	(0.0198)	(0.0198)	(0.0198)	(0.0198)
Norm nudges	0.0280**	0.0283**	-	-	-	-
	(0.0135)	(0.0135)				
Positive descriptive norm			0.0238	0.0244	0.0238	0.0244
			(0.0198)	(0.0197)	(0.0198)	(0.0197)
Injunctive norm	-	-	0.0509***	0.0522***	0.0509***	0.0522***
			(0.0198)	(0.0197)	(0.0198)	(0.0197)
Dynamic norms	-	-	0.0218	0.0217	-	-
			(0.0148)	(0.0147)		
Quantitative dynamic norm	-	-	-	-	0.0383*	0.0373*
					(0.0198)	(0.0198)
Qualitative dynamic norm	-	-	-	-	0.0105	0.0120
					(0.0198)	(0.0198)
Trending norm	-	-	-	-	0.0165	0.0157
					(0.0198)	(0.0197)
Constant	0.152***	0.111	0.152***	0.110	0.152***	0.110
	(0.0114)	(0.0769)	(0.0114)	(0.0769)	(0.0114)	(0.0769)
Observations	4,956	4,956	4,956	4,956	4,956	4,956
R-squared	0.004	0.014	0.004	0.015	0.005	0.015
Controls	NO	YES	NO	YES	NO	YES

Note: The control variables include insurance provider, type of insurance, ethnic group, displaced by armed forces, Colombian nationality, and low stratum. All the controls are dummy variables. The unreported coefficient values for the Probit model show the same coefficients as the OLS estimation. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Column three in Table 1 shows the impact of descriptive and injunctive norms on second-dose HPV vaccinations for *trendsetters*. Column three shows that the average second-dose HPV vaccination rate of girls whose parents received the descriptive norms treatment is 2.4 percent higher than the control group's average. This result is not statistically significant and remains the same after controlling for covariates. Thus, the result does not support H2, which states that descriptive norms do not increase second-dose HPV vaccination rates for trendsetters.

This result does not show evidence of the expected "boomerang effect" of descriptive norms (Cialdini, 1990; Bicchieri and Xiao, 2009; Bicchieri and Dimant, 2022; Kuang et al., 2020;

Schultz et al., 2007). The backfire effect might still be present in the population that corrected overstated beliefs of the descriptive norm, as in Schultz et al. (2007). However, our setting limits the strength of our conclusion since beliefs on current vaccination rates held by the participants are not elicited, impeding analysis of heterogenous effects of descriptive norms on HPV vaccinations.

Regarding the effect of injunctive norms, the average second-dose HPV vaccination rate of *trendsetters* in the injunctive norm treatment is 5.1 percent higher than the control group's average. The result is robust to the specification, including covariates, and statistically significant at the 99 percent confidence level. This is a 33.55 percent difference from the control group, and the result reaches statistical significance after the Bonferroni correction for multiple comparisons.

This finding supports H3, which states that injunctive norms increase trendsetters' second-dose HPV vaccinations. Moreover, the result supports the literature that finds injunctive norms effective at increasing a minority behavior (Allcott, 2011; Bonan et al., 2020; Jachimowicz et al., 2018; Ryo et al., 2021; Schultz et al., 2007). A potential mechanism, as suggested by Bicchieri and Dimant (2022) and Hauser (2018), is that injunctive norms address the underlying motivations of trendsetters.

Column three in Table 1 also shows the effects of dynamic norms loosely defined. The estimation shows a marginal coefficient of 2.2 percent, which is not statistically significant compared to the control group. Albeit positive, this result does not support H4, which states that dynamic norms increase second-dose HPV vaccinations. Furthermore, this goes against recent studies which find that dynamic norms effectively increase minority behaviors (Aldon et al., 2021; Cheng et al., 2022; Mortensen et al., 2017; Loschelder et al., 2019; Sparkman and Walton, 2017; Milkman et al., 2022).

The results from column five in Table 1 disentangle the effect of each separate dynamic norm treatment on second-dose HPV vaccinations for trendsetters. The marginal coefficients for the trending, qualitative, and quantitative dynamic norms show a positive sign. However, none are statistically significant at a 95 percent confidence level. These results are relevant for H5 and H6, which state that trending and qualitative norms increase second-dose HPV vaccinations. With the caveat that this effect might be due to a lack of power,[7] these results do not support hypotheses H5 and H6.

The quantitative dynamic norm shows a marginal effect of 3.8 percent statistically significant at the 90 percent confidence level compared to the control group. The coefficient remains the same when we control for covariates. Although there is a large effect equivalent to a 25 percent difference in second-dose HPV vaccinations compared to the control group, the result does not show significant effects with a Bonferroni correction for multiple comparisons.

A heterogeneous effects estimation shows that quantitative dynamic norms have a negative effect on the population with subsidized insurance. The marginal coefficient is -11.4 percent, statistically significant at the 95 percent confidence level (See Table A4 in the Appendix). This result is consistent with studies that find boomerang effects of norm nudges in sub-populations (Cialdini, 1990; Bicchieri and Xiao, 2009; Bicchieri and Dimant, 2022; Kuang et al., 2020; Schultz et al., 2007). The result does not show significant effects with a Bonferroni correction for multiple comparisons.

Lastly, the results show that the most effective nudge of the intervention to increase second-dose HPV vaccination for trendsetters is the experimental control for increasing second-dose HPV vaccination. This treatment shows a marginal increase of 7.5 percent compared to the control group. The result is robust to including covariates and statistically significant at a 99 percent confidence level. This difference is equivalent to an approximately 50 percent increase compared to the control group's average and reaches statistical significance after the Bonferroni correction for multiple comparisons.

The experimental control is a non-norm nudge containing two elements: the recipient's name, and the sender's information, in this case, the Secretariat of Health. The content of the experimental control is the following, "Get your daughter the second dose of the HPV vaccine: give her all the protection." Thus, it can be considered a reminder. This result supports the vast literature on the reminders' role in increasing vaccination (Briss et al., 2000; Jacobson et al., 2005; Busso, 2015; Busso, 2017; Stockwell, 2012; Szilagyi, 2013).

[7] We conducted a power analysis to estimate the number of parents assigned to each treatment. However, we use only a subset of that sample to analyze the *trendsetters* specifically. See Table A5 in the Appendix for regressions over the entire sample in columns one and two.

This intervention based on SMS norm nudges is highly cost-effective in increasing second-dose HPV vaccinations of trendsetters. The cost per additional girl vaccinated is estimated at USD \$0.61. This cost considers the cost of all messages bought for the intervention and the marginal vaccination rate per treatment. However, a simple reminder to the same population would cost USD \$0.24. This is a cost reduction of 61 percent.

6. Conclusion

In this study, we run a field experiment through a text message campaign to increase the minority behavior of second-dose HPV vaccinations for trendsetters in Bogota, Colombia. The target population is parents with daughters between 9 and 12 who already have the first dose of the HPV vaccine. Because this population of parents has acted against social norms in the past, we refer to them as the HPV vaccination trendsetters. The vaccination rate of the first-dose HPV vaccine at the time of the experiment is approximately 30 percent, and the second-dose HPV vaccination rate is 9 percent.

We test the effect of five norm nudges, one experimental control, one policy control, and one control group on second-dose HPV vaccinations. The main findings are the following. First, we find a lack of statistically significant evidence of the effect of dynamic norms in increasing second-dose HPV vaccinations for trendsetters. Second, the results show a positive statistically significant effect of injunctive norms on second-dose HPV vaccinations for trendsetters. The difference in the mean of vaccinations for the injunctive norm treatment group and the control group was sizable at 33 percent. Third, the most effective nudge at increasing second-dose HPV vaccination is the experimental control, i.e., a personalized reminder signed by the Secretariat of Health. The experimental control shows a statistically significant increase of 7.5 percent, equivalent to an approximately 50 percent increase compared to the control group's second-dose HPV vaccination average.

The results in this study do not support other studies that find dynamic norms effective at increasing minority behaviors. However, the results support the literature that finds the effect of norm nudges depends on the underlying preferences of the target population.[8] The differences in

[8] For example, Castro and Scartascini (2015) find that a descriptive nudge does not affect the average population's behavior; however, it increases tax compliance on previously non-compliers but decreases compliance on previously compliant taxpayers. Unlike this study, norm nudge experiments typically find differential effects of norm nudges by

the effect of norm nudges containing the same social norm components on first-dose and second-dose HPV vaccinations illustrate the importance of understanding the underlying characteristics of the population to develop effective nudge interventions. This study's results allow us to reflect on trendsetters' underlying preferences.

Trendsetters who have gone against social norms may have preferences less influenced by others' behaviors, resulting in the ineffectiveness of dynamic norm nudges. Additionally, these individuals may adhere to a moral rule for behavior that favors their daughters' health, explaining the significant impact of injunctive norms on second-dose HPV vaccination. Furthermore, a simple reminder, i.e., the experimental control, is highly effective for trendsetters who may have forgotten to administer the second HPV vaccine six months after the first dose.

The implications of this study's findings are relevant for developing cost-effective public health nudge interventions. The estimated cost per additional vaccinated girl in this study was approximately USD 0.61. However, had the simple reminder been implemented across all groups, the cost would have decreased to USD 0.24 per additional vaccinated girl. This estimation highlights the importance of experiments that find effective nudges for the target population, as they can help keep the costs low when implemented at scale. When vaccination completion is the problem, important public health goals can be achieved by norm nudges or reminders. Furthermore, given the link between HPV vaccination and reduced risk of cervical cancer, norm nudge interventions and reminders may ultimately lower public resources allocated to cancer-related medical care.

analyzing heterogeneous effects (Allcott, 2011; Beshears et al., 2015; Bicchieri and Dimant, 2022; Castro and Scartascini, 2015; Fellner et al., 2013; Ferraro et al., 2011; Kantorowicz-Reznichenko, 2021; Peth, 2018; Richter et al., 2018; Schultz et al., 2007).

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Appendix

Table A1. Text Message Content by Norm Nudge Treatment and Social Norms Element

Treatment	Norm nudge text message content	Social norms element
Control	*No message*	None
Policy control	*Vaccinate them: give your son or daughter all the protection. Consult http://aldm.co/Eq2vT9s for the nearest location. Secretariat of Health*	None
Experimental Control	*Hi [Name of the parent]. Get your daughter the second dose of the HPV vaccine: give her all the protection. Secretariat of Health*	None
Positive descriptive norm	*Hi [Name of the parent]. 8% of parents in your area have already gotten the second dose of the HPV vaccine for their daughters. Secretariat of Health*	Descriptive norm
Injunctive norm	*Hi [Name of the parent]. 8% of parents in your area have already gotten the second dose of the HPV vaccine for their daughters. You still have not :(. Secretariat of Health*	Descriptive and Injunctive norm (emoticon)
Quantitative dynamic norm	*Hi [Name of the parent]. 8% of parents in your area have already gotten the second dose of the HPV vaccine for their daughters, and more and more are doing it. Secretariat of Health*	Dynamic norm
Qualitative dynamic norm	*Hi [Name of the parent]. More and more parents in your area are giving their daughters their second dose of the HPV vaccine. Secretariat of Health*	Dynamic norm
Trending norm	*Hi [Name of the parent]. Since 2016, the number of parents in your town who got the second dose of the HPV vaccine for their daughters increased by 83%. Secretariat of Health*	Dynamic norm

Table A2. Descriptive Statistics of the Sample

VARIABLES	N	Mean	SD	Min	Max
EPS Sanitas	4956	0.16	0.37	0	1
EPS Salud Total	4956	0.13	0.34	0	1
EPS Famisanar	4956	0.18	0.39	0	1
EPS Compensar	4956	0.16	0.36	0	1
EPS Capital Salud	4956	0.14	0.35	0	1
Contributory Insurance	4956	0.77	0.42	0	1
Uninsured	4956	0.03	0.18	0	1
Subsidized insurance	4956	0.16	0.37	0	1
Ethnic group	4956	0.00	0.07	0	1
Displaced by the armed conflict	4956	0.01	0.11	0	1
Colombian nationality	4956	0.97	0.17	0	1
Low stratum	4956	0.70	0.46	0	1

Note: All observable characteristics of the sample are coded as dummy variables and get a value of 1 if it applies to the girl's record. Variables containing "EPS" refer to the insurance provider's name. Contributory insurance refers to insurance plans in which the employee contributes a portion of the premium, and the employer pays the rest. Uninsured, subsidized insurance, ethnic group, displaced by the armed conflict, Colombian nationality, and contributory insurance are binary. Low stratum is also binary and was constructed by grouping the two lowest neighborhood levels used by Bogota to characterize low socioeconomic status.

Table A3. Balance Table of Covariates per Treatment Arm of Trendsetters

VARIABLES	(1) Control	(2) Policy control	(3) Experimental control	(4) Positive descriptive	(5) Injunctive	(6) Quantitative dynamic	(7) Qualitative dynamic	(8) Trending	T-tests (1)-(2)	(1)-(3)	(1)-(4)	(1)-(5)	(1)-(6)	(1)-(7)	(1)-(8)
Sanitas	0.182	0.178	0.162	0.141	0.159	0.154	0.133	0.152	-0.004	-0.020	-0.041**	-0.023	-0.028	-0.049**	-0.030
	(0.012)	(0.016)	(0.016)	(0.015)	(0.016)	(0.015)	(0.015)	(0.015)							
Salud Total	0.122	0.129	0.160	0.147	0.116	0.118	0.148	0.132	0.007	0.038**	0.025	-0.006	-0.004	0.026	0.010
	(0.010)	(0.014)	(0.016)	(0.015)	(0.014)	(0.014)	(0.015)	(0.014)							
Famisanar	0.181	0.204	0.160	0.185	0.194	0.190	0.190	0.178	0.023	-0.021	0.004	0.013	0.009	0.009	-0.004
	(0.012)	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)							
Compensar	0.156	0.142	0.143	0.163	0.154	0.167	0.155	0.174	-0.014	-0.012	0.007	-0.002	0.011	-0.000	0.018
	(0.011)	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)	(0.015)	(0.016)							
Capital Salud	0.143	0.136	0.156	0.149	0.143	0.134	0.141	0.147	-0.006	0.013	0.006	0.000	-0.009	-0.002	0.004
	(0.011)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)							
Contributory	0.770	0.765	0.740	0.759	0.754	0.799	0.759	0.775	-0.004	-0.029	-0.011	-0.016	0.029	-0.011	0.006
	(0.013)	(0.018)	(0.019)	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)							
Uninsured	0.029	0.035	0.038	0.034	0.034	0.024	0.036	0.029	0.005	0.009	0.005	0.005	-0.006	0.007	-0.000
	(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.008)	(0.007)							
Subsidized	0.159	0.156	0.189	0.163	0.170	0.149	0.175	0.161	-0.003	0.030	0.004	0.011	-0.011	0.016	0.002
	(0.011)	(0.016)	(0.017)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)							
Ethnic group	0.006	0.004	0.005	0.007	0.004	0.002	0.005	0.004	-0.003	-0.001	0.001	-0.003	-0.005	-0.001	-0.003
	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)	(0.003)							
Displaced	0.014	0.018	0.016	0.009	0.014	0.004	0.013	0.014	0.005	0.003	-0.005	0.001	-0.010*	-0.001	0.001
	(0.004)	(0.006)	(0.005)	(0.004)	(0.005)	(0.003)	(0.005)	(0.005)							
Colombian	0.975	0.962	0.966	0.976	0.966	0.973	0.971	0.971	-0.013	-0.009	0.002	-0.009	-0.002	-0.004	-0.004
	(0.005)	(0.008)	(0.008)	(0.006)	(0.008)	(0.007)	(0.007)	(0.007)							
Stratum low	0.710	0.680	0.721	0.694	0.712	0.688	0.690	0.681	-0.030	0.011	-0.016	0.002	-0.021	-0.020	-0.029
	(0.014)	(0.020)	(0.019)	(0.020)	(0.019)	(0.020)	(0.020)	(0.020)							
N	1099	550	551	552	552	552	548	552	1649	1650	1651	1651	1651	1647	1651

Note: All observable characteristics of the sample are coded as dummy variables and get a value of 1 if it applies to the girl's record. The values above represent the mean value of each observable variable across treatment arms. Standard errors in parentheses.

Table A4. Quantitative Norms Result in a Negative Heterogeneous Effect on the Subsidized Population

VARIABLES	(1) Colombian **Applied vaccine**	(2) Displaced **Applied vaccine**	(3) Ethnic **Applied vaccine**	(4) Contributory **Applied vaccine**	(5) Subsidized **Applied vaccine**	(6) Stratum low **Applied vaccine**	(7) Uninsured **Applied vaccine**
Policy control	-0.0264	-0.163	-0.154	-0.0530	0.0609	0.0638	-0.0036
	(0.111)	(0.156)	(0.304)	(0.0468)	(0.0544)	(0.0429)	(0.112)
Experimental control	-0.0209	0.0138	-0.248	-0.0425	0.0490	-0.0082	-0.0419
	(0.115)	(0.161)	(0.262)	(0.0459)	(0.0518)	(0.0439)	(0.108)
Positive descriptive	-0.0410	-0.293	0.114	-0.0099	0.0146	0.0141	0.0007
	(0.129)	(0.197)	(0.239)	(0.0465)	(0.0537)	(0.0432)	(0.113)
Injunctive norm	0.0706	-0.189	-0.142	-0.0619	0.0631	0.0393	0.0519
	(0.115)	(0.168)	(0.305)	(0.0463)	(0.0531)	(0.0436)	(0.112)
Quantitative dynamic norm	-0.175	0.145	-0.194	0.0433	-0.114**	-0.0368	0.152
	(0.123)	(0.286)	(0.407)	(0.0486)	(0.0551)	(0.0430)	(0.127)
Qualitative dynamic norm	0.0803	-0.148	0.191	-0.0132	0.0176	0.0009	-0.0263
	(0.121)	(0.175)	(0.262)	(0.0466)	(0.0528)	(0.0431)	(0.110)
Trending norm	0.0275	-0.158	-0.153	-0.0357	0.0481	0.0433	-0.0128
	(0.121)	(0.167)	(0.306)	(0.0473)	(0.0539)	(0.0428)	(0.118)
Observations	4,956	4,956	4,956	4,956	4,956	4,956	4,956
Controls	YES	YES	YES	YES	YES	YES	YES

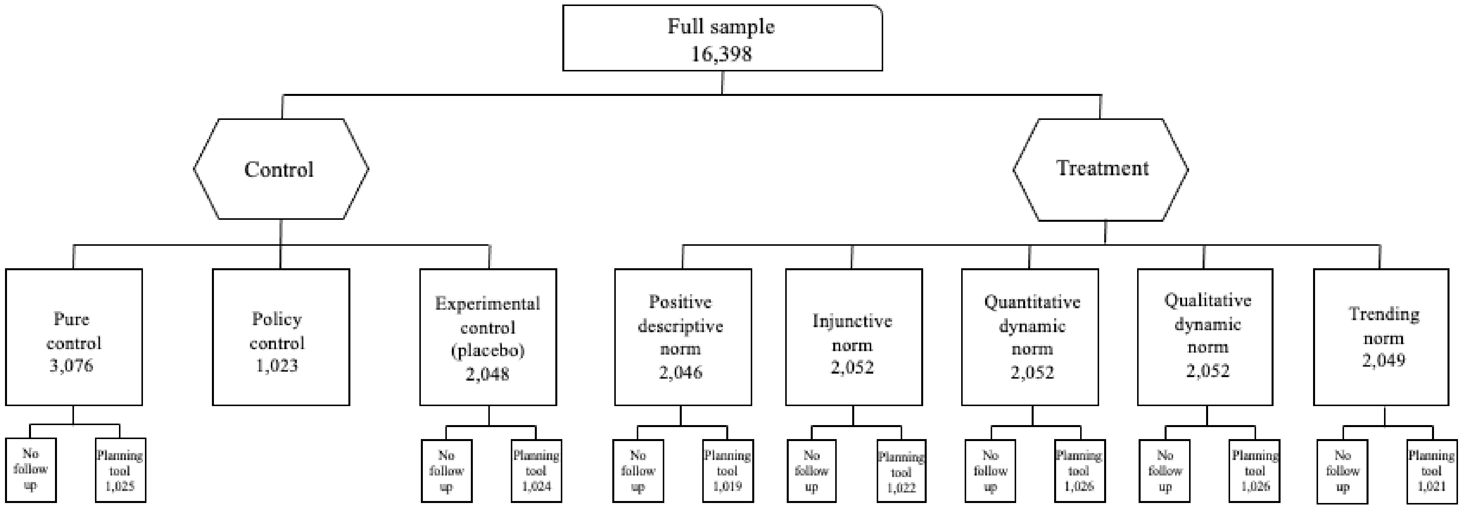
Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A5. Regression Results of the Full Sample, per Pre-registered Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Target Population	9-17	9-17	9-17	9-12	9-12	9-12
VARIABLES	Vaccination rate	Vaccination rate	Vaccination rate	Vaccination rate	Vaccination rate	Vaccination rate
1. Policy control	-0.0170	-0.0100	-0.00935	-0.0288	-0.0191	-0.0109
	(0.0126)	(0.0127)	(0.0129)	(0.0193)	(0.0195)	(0.0198)
2. Experimental control	0.0466***	0.0431***	0.0465***	0.0538***	0.0490***	0.0760***
	(0.00993)	(0.00997)	(0.0129)	(0.0152)	(0.0153)	(0.0198)
3. Positive descriptive	0.0102	0.00675	0.00930	0.0226	0.0179	0.0244
	(0.00992)	(0.00996)	(0.0129)	(0.0152)	(0.0153)	(0.0197)
4. Injunctive norm	0.0345***	0.0311***	0.0445***	0.0298*	0.0250	0.0522***
	(0.00992)	(0.00996)	(0.0129)	(0.0152)	(0.0153)	(0.0197)
5. Quant dynamic norm	0.00707	0.00361	0.0126	0.0283*	0.0236	0.0373*
	(0.00992)	(0.00996)	(0.0129)	(0.0152)	(0.0153)	(0.0198)
6. Qual dynamic norm	0.00266	-0.000796	-0.0113	0.0191	0.0143	0.0120
	(0.00992)	(0.00996)	(0.0129)	(0.0153)	(0.0153)	(0.0198)
7. Trending norm	0.0175*	0.0141	0.00186	0.0317**	0.0270*	0.0157
	(0.00992)	(0.00996)	(0.0129)	(0.0152)	(0.0153)	(0.0197)
Planning tool		0.0208***	-		0.0291***	-
		(0.00567)			(0.00871)	
Constant	0.0990**	0.0920*	0.0709	0.187***	0.176***	0.110
	(0.0471)	(0.0471)	(0.0599)	(0.0605)	(0.0606)	(0.0769)
Observations	16,398	16,398	9,235	8,807	8,807	4,956
R-squared	0.030	0.031	0.031	0.011	0.012	0.015
Control variables	YES	YES	YES	YES	YES	YES
Link group included	YES	YES	NO	YES	YES	NO
Link control	NO	YES	-	NO	YES	NO
Control mean	.1317	.1317	.1238	.1695	.1695	.1520

Note: The control variables are the observable characteristics of the sample, including uninsured, subsidized insurance, contributory insurance, ethnic group, whether the armed conflict displaced the girl, and whether the girl is Colombian. These variables get a value of 1 if it applies to the girl's record. Low stratum is also a binary variable and was constructed by grouping the two lowest neighborhood levels used by Bogota to characterize low socioeconomic status. See Figure 3A for the graphical representation of the experimental design containing the full sample of 9-17-year-old girls.

Figure 3A. Experimental Groups of Full Samples of 9-17-year-old Girls



Note: The stratified randomization allows us to study the pure effect of the norm nudges on trendsetters. To this end, we focus on the sub-sample parents of 9-12-year-old girls who were vaccinated during a minority norm scenario and who only received the norm nudge and not the planning tool. Thus, these parents received 8 messages, one per week, during the field experiment.