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Original research article

Can a social media campaign increase the use of long-acting reversible contraception? Evidence from a cluster randomized control trial using Facebook☆,☆☆

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ABSTRACT

Objective: To test whether an informational campaign carried out on social media increased use of long-acting reversible contraception (LARC).
Study design: We implemented a stratified cluster randomized control trial to identify the effect of an informational campaign carried out using Facebook advertisements designed to increase knowledge of the efficacy, ease of use and safety of LARC. We randomized all zip codes in a three-state study area to either a control group or a treatment group. Female Facebook users age 18–34 living in treated clusters received advertisements developed by the researchers in partnership with Planned Parenthood of Northern New England (PPNNE), which sponsored the campaign. We assessed changes in the number and rate of LARC insertions at PPNNE health centers by patients' treatment status.
Results: Facebook showed 1.8 million advertisements to women residing in 536 randomly assigned treatment clusters. Women living in 545 control clusters did not receive advertisements. We observed 152,743 patient visits across PPNNE's 21 health centers over a 26-month period spanning the advertisement campaign. After treatment, the number of LARC insertions increased by 5.7% (95% CI 0.4%–11.3%, p=.04) among patients living in treated relative to control clusters. This result, however, is driven by patients at a single large health center that was experiencing an increase in patient volume prior to the intervention. If we drop this clinic from the sample, we find no evidence that the campaign had an effect on LARC insertions (0.8% reduction, 95% CI −7.6 to 6.5, p=.83). Moreover, if we control for patient volume, we also find no evidence that the campaign increased insertions per patient (0.5% relative increase in insertions, 95% CI −4.9% to 5.2%, p=.87).
Conclusion: We conclude that the intervention did not have a detectable impact on LARC insertions in the 4 months after the ad campaign.
Implications: This project demonstrates the importance of evaluating the impact of resources invested on advertising with the goal of promoting public health.

1. Introduction

Despite the potential of long-acting reversible contraception (LARC) methods including the intrauterine device (IUD) and implant to reduce unintended pregnancy rates in the United States, there has been little substitution from less effective contraceptive methods to LARC. Between 2008 and 2014, LARC use among contracepting women rose from 6% to 14%, but this change can be attributed to a reduction in sterilization rather than from women switching from other hormonal and coital methods such as the pill and condoms [1].

Survey evidence suggests a major barrier to LARC use is a lack of accurate information about its safety, efficacy and ease of use [2–4]. In a 2009 survey of unmarried men and women in their twenties, 75% had heard of IUDs, but most indicated that they knew little or nothing

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☆☆ Declaration of interest: Myers reports having served in the past year as an expert witness in litigation involving abortion regulations. This activity began after the design and implementation of this study. Graff is employed by Planned Parenthood of Northern New England. Byker has no interests to declare.
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about them, and only half knew that IUDs are more effective than the pill [2]. In a separate survey of women in the St. Louis area, 51% of respondents stated that they did not believe IUDs were safe, and 46% did not know that women who had not previously had children were candidates for IUDs [3].

This study explores whether a simple and low-cost information campaign carried out on social media can increase LARC use.

2. Methods

2.1. Study design and randomization

We implemented a stratified cluster randomized control trial to identify the effect of a LARC information campaign carried out using Facebook advertisements. The advertisements were designed by the researchers and sponsored by Planned Parenthood of Northern New England (PPNNE), the largest reproductive healthcare provider in the three states it services: Maine, New Hampshire and Vermont, which are the location of the study. The advertisements appeared during the month of October 2015. LARC insertions were observed both pre- and posttreatment using PPNNE health center data covering January 2014 through February 2016.

For our three-state study area, the United States Postal Service (USPS) zip code database lists 1081 zip codes, which make up the clusters in our study. The USPS associates each of these zip codes with one of 1003 unique "primary cities" and additionally associates many zip codes with smaller secondary towns sharing the same zip code as the primary city. We used the Stata *geonear* module to calculate the linear distance between the geographic centroid of each primary city and the nearest PPNNE health center [5]. We then divided the primary cities into five strata according to distance to the nearest health center and randomly assigned treatment status to primary cities within each stratum.

Under this randomization strategy, in cases where a single primary city contains multiple zip codes, all zip codes within the primary city received the same treatment status. In cases where multiple small neighboring towns share the same zip code, all of these towns received the same treatment status. Randomizing in this way increases the accuracy of the advertisement targeting because it does not require Facebook to distinguish between zip codes within a city or between small neighboring towns that share the same zip code.

2.2. The accuracy of Facebook's geographic targeting

Facebook identifies residence based on the "current city" users enter in their profiles, validated with IP address and friends' profile locations. We are unaware of published attempts to assess the accuracy of Facebook's geographic targeting of advertisements. Because this is crucial to the research design, we implemented a postintervention survey intended to compare respondents' self-reported zip codes to their treatment assignment. The survey design and results are described in detail in the Appendix.

2.3. Intervention

Eligible Facebook users residing in the treatment areas received five informational advertisements during October 2015 (Fig. 1). The two "efficacy ads" provided infographics comparing the typical use failure rate of IUD and the birth control implant to that of the birth control pill as estimated by Trussell [6]. The two "ease-of-use ads" reported the number of birth control pills a woman would have to take in the time that the levonorgestrel IUD is labeled for use (5 years) and the

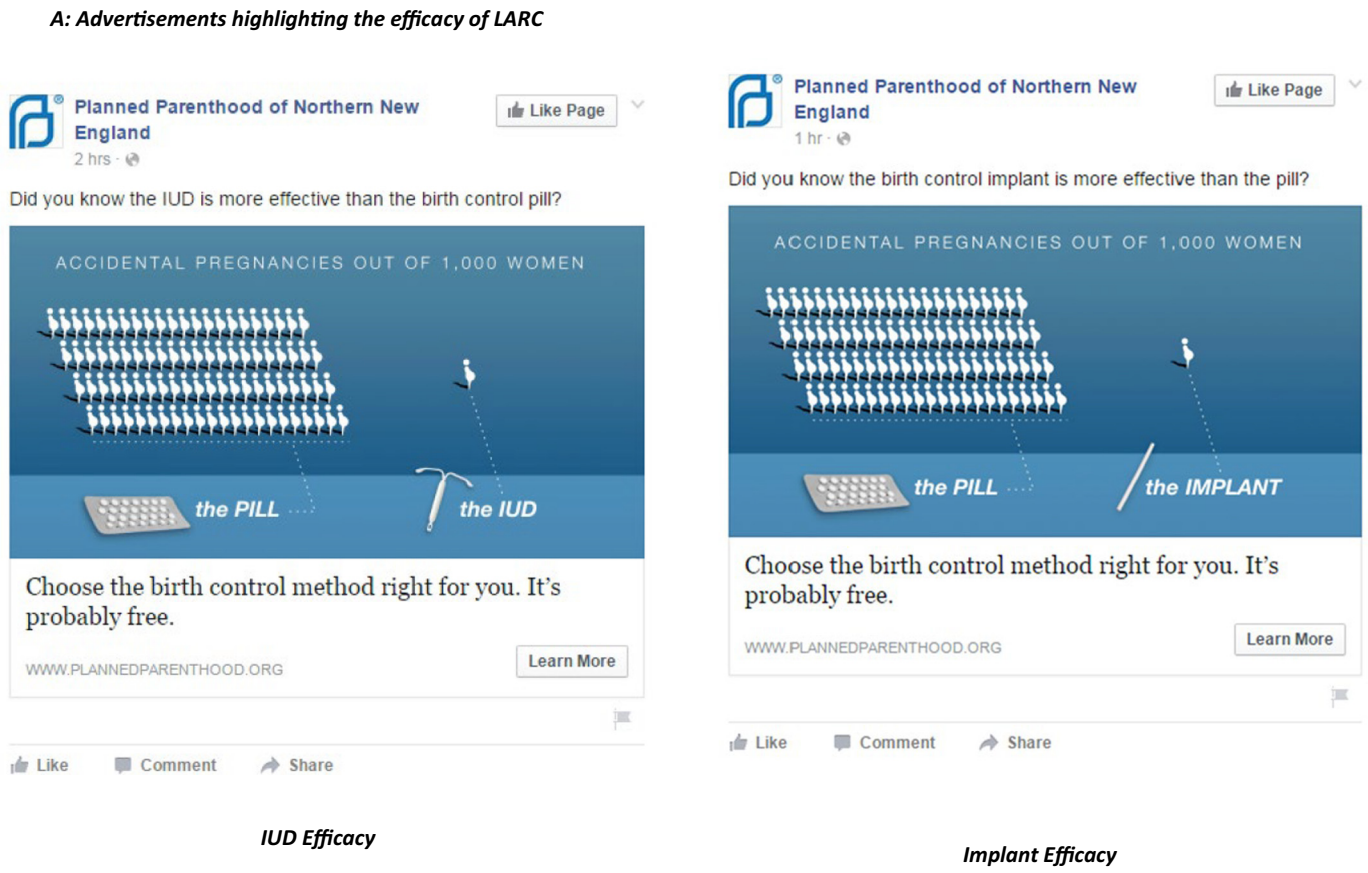
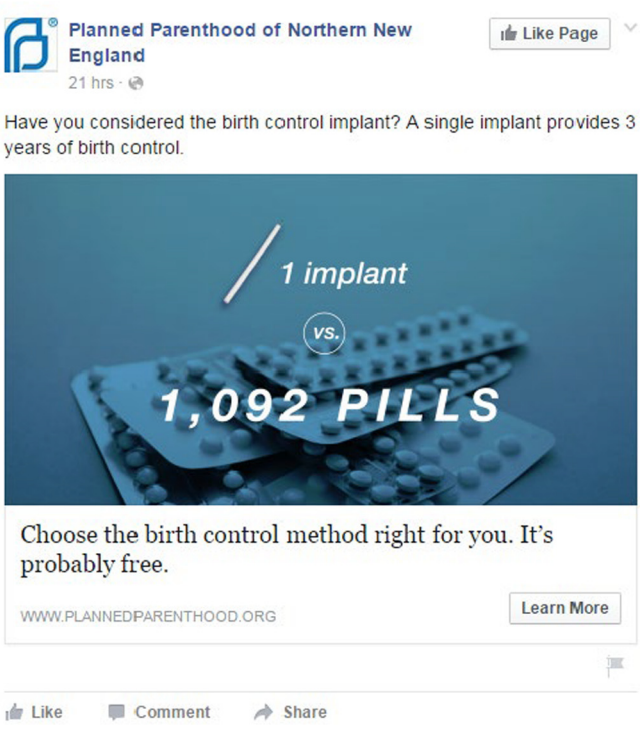


Fig. 1. Facebook advertisements. (A) Advertisements highlighting the efficacy of LARC IUD efficacy. (B) Advertisements highlighting the ease-of-use of LARC. (C) Advertisement highlighting the safety of LARC.

B: Advertisements highlighting the ease-of-use of LARC

IUD Ease of Use



Implant ease of use

Fig. 1 (*continued*).

Nexplanon contraceptive implant is labeled for use (3 years). The "safety ad" featured the headline "Today's IUDs and implants are safe for young women and their future fertility." This message is intended to address the misconception among survey respondents that LARC methods are dangerous and not appropriate for young women [2,3].

The authors designed all three advertisements with extensive input and oversight from PPNNE's advertising staff, which relies on findings from third-party focus groups and adopts approaches in keeping with national Planned Parenthood messaging on birth control. The advertisements provided factual information in a noncoercive manner. Each advertisement included PPNNE's standard advertisement tagline: "Choose the birth control method that's right for you. It's probably free."

2.4. Patient outcome measures

The primary outcomes of interest were the number and rate of LARC insertions at PPNNE's 21 health centers. PPNNE provided the researchers with anonymized patient-level data from January 2014 through February 2016. Each health center received patients from both treated and control zip codes. Patients' treatment status was determined by patient-reported zip code of residence in PPNNE records. These data contain 152,743 visit records for women aged 15–34 residing in the study area observed during a 26-month period spanning January 2014 to February 2016.

2.5. Statistical analysis

Our most simple difference-in-difference research design relies on patient records for the 4-month period following treatment (November 2015–February 2016) and for the same 4months 1 calendar year prior (November 2014–February 2015), comparing changes in the number and rate of LARC insertions provided to patients from the treated and control zip codes.

Given that we have health center records for all months from January 2014 through February 2016, our preferred difference-in-difference specification incorporates all available months of the pretreatment period to better control for any preintervention differences across treatment and control groups. We estimated the following Poisson model:

$$E(LARC_{e,t}|treatment_e, month_t) = exp\left[\beta_0 + \beta_1 treatment_e + \sum_{t=1}^{t=25} \alpha_t month_t + \beta_1 (treatment_e * I(month_t > October\ 2016))\right] \quad (1)$$

The outcome variable is the number of monthly LARC insertions to women living in experimental group e (treatment or control) in month t. The explanatory variable of interest is $(treatment_e * I(month_t > October\ 2016)$, which indicates the treatment group observed posttreatment. The indicator $treatment_e$ controls for time-invariant differences in LARC insertions between treatment and control, and a vector of monthly fixed effects controls for spatially invariant monthly shocks in LARC insertions.

We estimate model 1 for all LARC insertions and for IUD and implant insertions separately. We also estimate this model after adjusting for exposure to patient visits so that the results may be interpreted as an effect on the rate of LARC insertions per patient visit. Note that percent effects from the Poisson model are calculated as $(e^{\beta} - 1) \times 100\ \%$.

C: Advertisement highlighting the safety of LARC

IUD and Implant Safety

Fig. 1 (*continued*).

3. Results

Of 1081 zip codes, 536 were randomly assigned to the treatment group and 545 were randomly assigned to the control group. Fig. 2 maps the locations of PPNNE health centers and locations of treatment and control clusters in the study region as identified by zip code boundaries. Visually, treated clusters appear to be randomly distributed across the region, and we used data from the USPS to verify that the treatment and control groups contain approximately equal numbers of primary cities and similar population sizes. The Appendix provides a table illustrating the number of primary cities and populations by stratum and treatment status.

Table 1 summarizes the characteristics of patients visiting PPNNE's 21 health centers prior to the intervention. We limit the sample to patients aged 18 to 34, the age range targeted by our intervention, living in zip codes in the study area. We observe no substantial or statistically significant differences between treated and control groups at baseline in age, race or the purpose of the patient's visit. Treatment assignment, which stratified by distance to the nearest Planned Parenthood clinic but not by state of residence, did result in a control group with relatively greater representation of New Hampshire residents (difference=18.6 percentage points, 95% CI 1.7–35.4, p=.03). At baseline, the control group also was slightly less likely than the treatment group to pay with private insurance (difference=−4.2 percentage points, 95% CI −0.2 to 8.5, p=.06). These baseline differences do not appear to be correlated with the key outcome of interest, LARC insertion rates, which are similar for both treatment and control groups at baseline (difference=0.2 percentage points, 95% CI −0.4 to 0.7,p=.52). Our difference-in-difference research design accounts for these small differences at baseline.

In total during the month of October 2015, the advertisements were shown 1.8 million times to 126,231 unique women, for an average of 14.4 advertisements per woman. Based on the USPS estimate of the population of women ages 18 to 34 residing in the treatment areas, roughly 80% of the targeted population saw at least one advertisement. Eighty-two percent of the advertisements appeared in the desktop right column, 12% appeared in the mobile news feed, and 6% appeared on third-party mobile apps and websites. The results of our separate survey of Facebook users, described in the Appendix, suggest that Facebook is accurate in targeting these advertisements by zip codes; we find that 87.4% of respondents (95% CI using exact binomial distribution 79.7–92.9) from the study region self-reported zip codes in the intended treatment group. The total cost of the campaign was $1968, which was paid for by PPNNE.

We begin by considering a simple difference-in-difference comparison of total LARC insertions by treatment status in the 4 months following the advertisement campaign ("after" treatment) and the corresponding 4-month period 1 calendar year prior ("before" treatment, or "baseline"). At baseline, LARC insertions were similar for patients from treatment and control zip codes: 556 LARC insertions for women from treated zip codes and 543 LARC insertions for women from control zip codes, a difference of 13 insertions (95% CI −52 to 78, p=.70). After treatment, the number of LARC insertions was greater in the treated zip codes: 816 LARC insertions for women from treated zip codes versus 697 for women from control zip codes, a difference of 119 insertions (95% CI 43–195, p<.01). The corresponding difference-in-difference estimate of the effect of the program is 106 additional insertions due to treatment (95% CI 6–206, p=.04). If we instead consider LARC insertion rates *per 100 client visits*, the differences are neither large nor statistically significant in either period. The difference-in-difference estimate of the effect of the program is 0.5 fewer LARC insertion per 100 client visits (95% CI −0.4 to 1.4, p=.25).

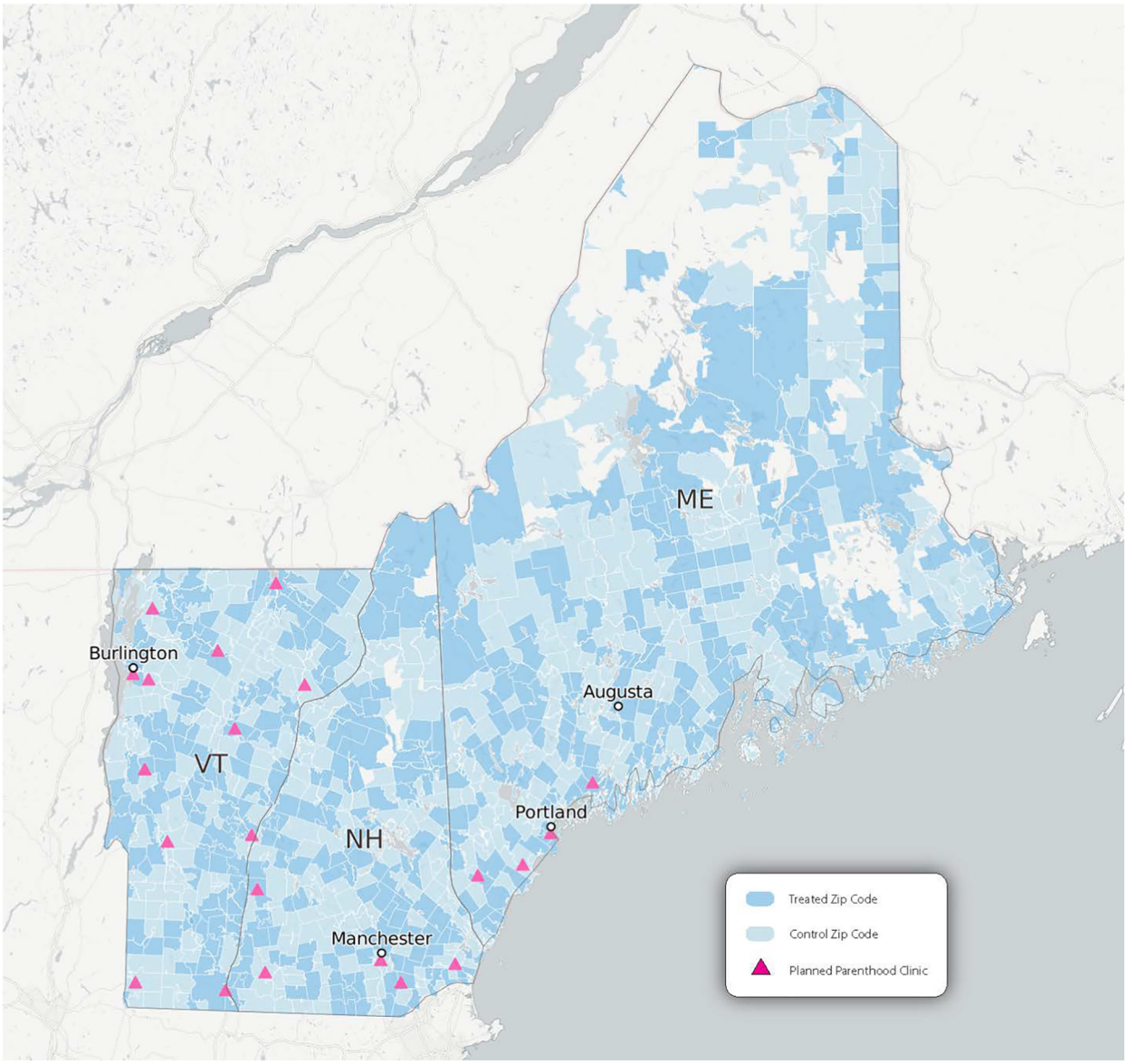


Fig. 2. Map of Northern New England (Vermont, Maine and New Hampshire) indicating treatment and control zip codes and Planned Parenthood of Northern New England locations. Note: The white areas correspond to rural areas that lack postal delivery service and hence are not assigned zip codes. The small number of women residing in these extremely rural areas would be assigned the zip code for the nearest post office

Fig. 3 presents trends in LARC insertions for the treatment and control groups over all available months of data, from January 2014 through February 2016, allowing one to examine pretreatment trends. Panel A gives cause for concern in inferring that posttreatment differences in LARC insertions can be attributed to treatment. Visually, it appears that while the treated and control groups exhibited similar numbers of LARC insertions through early 2015, the treatment group began to deviate from this trend in the months prior to treatment. Moreover, panels B and C illustrate that this deviation in trend is due to an increase in LARC insertions at a single large health center, the Burlington Health Center. The Appendix presents trends in LARC insertion rates.

Table 2 presents coefficients from our preferred specification [Eq. (1)]. The inclusion of all months and month fixed effects decreases the estimated treatment effect relative to that described in our most simple difference-in-difference comparison. Columns 1–3 of Table 2 suggest that the information campaign increased LARC insertions by 5.7% (95% CI 0.4%–11.3%, p=.04), IUD insertions by 2.9% (95% CI −2.8% to 7.8%, p=.24) and implants by 15.0% (95% CI 3.5%–27.7%, p=.01). While two of the three results are statistically significant, all are imprecisely estimated. The coefficient on the indicator for being from a treated zip code is large and significant in every case, providing further evidence of the importance of controlling for precampaign differences.

Column 4 indicates that there were significantly more patients from treatment zip codes visiting PPNNE clinics following the ad campaign. In columns 5–7, we reestimate model 1 using number of patient visits to adjust for exposure. The estimates in columns 5–7 no longer suggest a positive treatment effect on total LARC insertions (0.5% relative increase in insertions, 95% CI −4.9% to 5.2%, p=.87), though the coefficient on implants remains statistically significant. Taken together, the results in panel A of Table 2 suggest that, to the extent that the campaign had an impact, it was on overall patient volume, not on rates of LARC insertion.

Panel B of Table 2 presents estimated treatment effects for the health center in Burlington, Vermont, and panel C presents estimated treatment effects for all of the remaining clinics combined. The results suggest that the evidence of a treatment effect observed in panel A is driven by an estimated 28.6% (95% CI 10.3%–50.0%, p<.01) increase in relative LARC insertions for the treatment group at the Burlington Health Center, while there is no detectible impact of the campaign

Table 1
Baseline characteristics of patients from treatment and control groups using PPNNE health center records for January 2014 through August 2015

	Control	Treatment	Difference	Standard error of difference
Demographics				
Nonwhite	6.9%	5.8%	1.1%	(1.1)
Age	24.8	24.8	<0.1%	(0.1)
State of residence				
Maine	19.2%	31.2%	−12.0%	(8.7)
New Hampshire	42.2%	23.7%	18.6%	(8.6)
Vermont	38.6%	45.1%	−6.5%	(10.2)
Payment type				
Private insurance	42.2%	46.3%	−4.2%	(2.2)
Public insurance	33.0%	29.1%	3.9%	(2.7)
Self-pay	24.8%	24.5%	0.3%	(2.9)
Visit purpose				
Family planning	81.4%	81.7%	−0.3%	(0.4)
LARC insertion	4.9%	5.1%	−0.2%	(0.3)
Abortion	6.4%	6.2%	0.1%	(0.3)
Pregnancy test	3.9%	3.5%	0.4%	(0.3)
STI	7.4%	7.6%	−0.2%	(0.4)
Sample size	60,763	64,888	125,651	

Summary statistics for PPNNE clinic data. The unit of observation is a patient visit. The sample has been restricted to observations prior to treatment for women aged 18 to 34 living in the three-state study area with nonmissing zip codes. Standard errors are clustered by patient zip code.

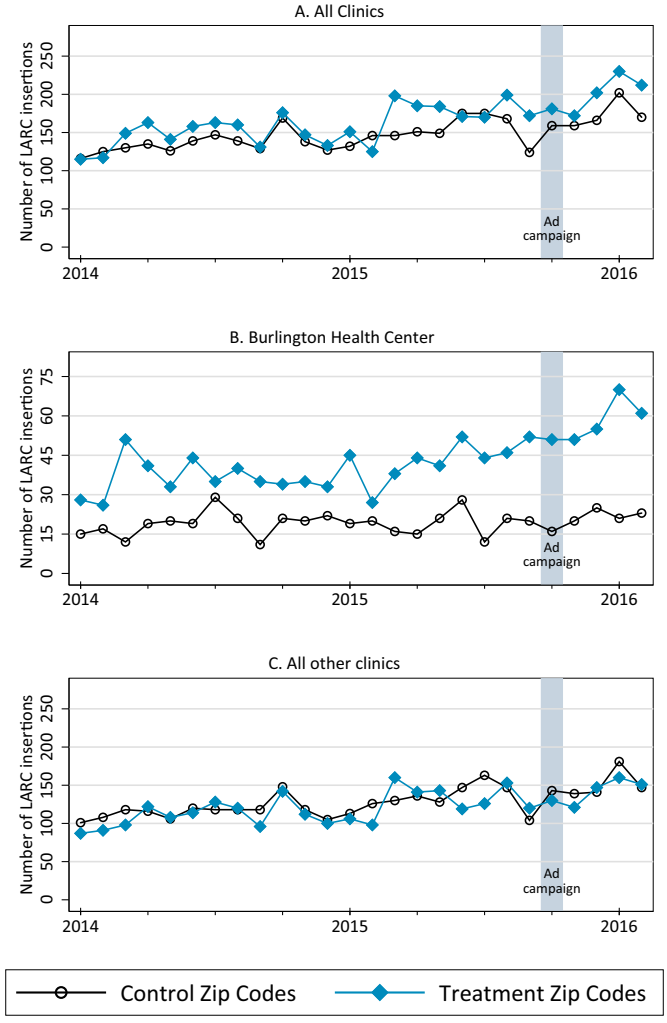


Fig. 3. Trend in total monthly LARC insertions provided by PPNNE health centers to women from the treated and control clusters. (A) All clinics. (B) Burlington Health Center. (C) All other clinics.

Table 2
Difference-in-difference Poisson estimates of the effects of the informational advertisement campaign on LARC insertions at PPNNE health centers of the period January 2014 through February 2016

Dependent variable: number of monthly insertions							
	No exposure adjustment				Exposure: number of patient visits		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	LARC	IUD	Implant	# Patients	LARC	IUD	Implant
Panel A: all clinics							
Estimated treatment effect (treat × after)	0.06 (0.03)	0.03 (0.02)	0.14 (0.05)	0.05 (0.01)	<0.01 (0.03)	−0.02 (0.03)	0.09 (0.05)
Panel B: Burlington, VT, only							
Estimated treatment effect (treat × after)	0.25 (0.08)	0.31 (0.13)	0.19 (0.12)	0.17 (0.06)	0.08 (0.05)	0.15 (0.08)	0.02 (0.14)
Panel C: not Burlington, VT							
Estimated treatment effect (treat × after)	−0.01 (0.04)	−0.04 (0.04)	0.06 (0.07)	0.02 (0.01)	−0.02 (0.04)	−0.05 (0.04)	0.04 (0.07)
No. months	25	25	25	25	25	25	25
No. experimental groups	2	2	2	2	2	2	2

Note: Estimated coefficients from a Poisson Model. The dependent variable in Columns 1-3 and 5-7 is the number of monthly LARC insertions for women living in the control and treated zip codes. The dependent variable in Column 4 is the number of patient visits. A treatment indicator and monthly fixed effects are included in all models. The exposure variable in Columns 5-6 is the total number of monthly visits. Standard errors, which appear in parentheses below coefficient estimates, are robust.

among the remaining clinics (0.8% decrease in insertions, 95% CI −7.6% to 6.5%, p=.83). Furthermore, when we adjust for exposure using patient visits, even in Burlington, we find no impact of the campaign on LARC insertion *rates*.

4. Discussion

Previous studies have demonstrated that training providers, offering in-person counseling and/or lowering financial barriers can increase LARC use [7–9]. The Contraceptive CHOICE project [8] and the Colorado Family Planning Initiative [9] targeted teens and young women at risk of unintended pregnancy, eliminating the cost of LARC while also training providers and offering in-person counseling to patients. A cluster randomized study at Planned Parenthood health centers across the country assigned training to providers on patient counseling and insertion of IUDS and implants but did not subsidize the cost of LARC [7].

This study offers evidence on the effectiveness of a different type of intervention, a simple, low-cost, low-effort advertising campaign on social media targeting potential patients. While we observe relatively more LARC insertions for members of the treatment group than the control group following treatment, an analysis of pretrends suggests that this is due to a rise in LARC insertions at a single large health center in Burlington, Vermont, prior to treatment. When we make various adjustments for this change, we observe no further evidence that the advertisement campaign had a detectable effect on LARC insertions.

Findings from this study should be interpreted in light of a number of potential limitations. While the target audience for our Facebook campaign was all women 18 to 34 in Northern New England, we only measured outcomes at PPNNE health centers. Next, our advertising campaign only ran for 1month, and we only measured outcomes for the 4 months following the campaign because PPNNE began a second

publicity campaign in March, which precludes use of subsequent data to estimate longer-term effects.

Finally, the Burlington Health Center was an outlier with a potential to lead to spurious conclusions. At the Burlington Health Center, 69.5% of clients (95% CI 68.9%–70.1%) resided in treated zip codes, including zip codes in the city of Burlington itself, while the remaining clients are from control zip codes, mostly in outlying towns. One interpretation of the finding is that that women living in the city of Burlington were particularly receptive to the information campaign. Counter to this story, however, panel B of Fig. 3 suggests that the deviation in LARC insertions for the treatment group at this clinic began *prior* to the intervention. We learned from PPNNE that there was a change in providers at the Burlington Health Center during the study period. Perhaps this change had disproportionate impacts on local women, who were treated, relative to women in outlying areas. While we cannot be certain of the explanation, we do view the relative increase in LARC insertions there as spurious evidence of a treatment effect. We observe no evidence of a treatment effect on total LARC insertions at the remaining clinics in the sample.

This finding highlights a potential pitfall of field experiments. The spurious evidence of a treatment effect should not be regarded as a failure of the randomization strategy, which produced a balanced sample in the period prior to the intervention. Rather, it appears that the findings were influenced by a pretreatment trend at a single location, one that could not be forecast in advance. Such trends are often not described in reports of randomized control trials because they are difficult or impossible for researchers to observe. It also is often difficult or impossible to obtain information about potential contaminating effects in field experiments due to on-the-ground changes in environment.

This study tests the effect of a simple, low-cost and easily implemented LARC information campaign targeted at potential patients, some of whom might choose LARC if they had increased information about their efficacy, safety and easeofuse. We conclude that a short social media campaign did not increase LARC insertions in the 4 months following the intervention. We view this study as an initial step in motivating and exploring whether there may be other simple and low-cost but effective interventions that would have this effect. This project also demonstrates the importance of evaluating the impact of resources invested on advertising with the goal of promoting public health.

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Appendix. Supplementary Materials

Supplementary data to this article can be found online at https://doi.org/10.1016/j.contraception.2019.04.001.

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