# Reducing the Supply of Unused Opioids: An Evaluation of a Community Health Center Opioid Return Program

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*More than one-third of opioid-related deaths are attributed to secondary users of prescription opioids with two-thirds obtaining painkillers from family and friends. Using a randomized control trial, we test the effectiveness of a community-based medication return program. Treated patients were 3.0 percentage points more likely to return medication relative to the control group, yet these effects remained small even when coupled with a text reminder, financial incentive, mail back envelope, or clinician involvement. Our results suggest that while medication return programs may remove opioids from some households, they are unlikely to meaningfully reduce the supply of opioids within a community.*

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Despite over a decade of policy intervention in various forms, the U.S. continues to suffer from high rates of prescription opioid abuse, addiction, and overdose. According to the latest data, approximately 82,000 people died of an opioid-involved overdose in the U.S. during 2022, which was 10 times the number of opioid involved overdose deaths in 1999 (CDC 2024a). About half (50.5 percent) of those who misused prescription pain relievers obtained the medication from a friend or relative (Lipari and Hughes, 2017), suggesting that this is a significant secondary source of opioids for nonmedical use. Although the U.S. opioid dispensing rate declined from 46.8 to 37.5 opioid prescriptions per 100 persons between 2019 and 2023, the rate

continues to be higher than that of most other developed countries (CDC 2024b). Moreover, opioid prescribing rates are even greater in U.S. counties with higher unemployment rates and lower median incomes, suggesting a potentially disparate impact on more economically vulnerable populations (CDC 2022).

This paper provides experimental evidence regarding the efficacy of an opioid return program designed to reduce the supply of unused prescription opioids within a community in the short-term, with the goal of decreasing the incidence of opioid use disorder (OUD) in the long-run that can lead to opioid overdose and death. Prior studies have shown that motivating patients to return controlled substances, including opioid medications, can be especially challenging. Controlled medications disposed of through drug "take-back" events and permanent drug donation boxes are estimated to account for a very small proportion (0.3 percent) of those dispensed, suggesting that these passive methods are unlikely to have much impact on the supply of opioids (Egan et al., 2017). Even when take-back programs are successful at getting patients to return moderate amounts of unused pain medication, controlled substances account for only 30 percent of the unit doses that are returned (Perry et al., 2014).

We intentionally designed our intervention to address specific factors that have been shown to pose a barrier to returning unused opioid medication, such as limited access to transportation, inflexible schedules and/or lower rates of English proficiency. For example, both the lack of knowledge and distance to a disposal kiosk has been shown to prevent families from returning unused medications despite being concerned about the safety of family members (particularly children) (Lystlund, et al., 2014). Yet over 80 percent of patients report that they would be more likely to return their medication if the kiosk was in a location that they visited frequently or if they were offered compensation (Buffington et al., 2019). Another survey found that non-English speakers were both less likely to both perceive a community problem with prescription drugs and be aware of take-back opportunities, with focus groups revealing lack of transportation and low awareness, police presence and infrequencies of events, and lack of multilingual marketing materials as barriers (Kearney et al., 2019).

Recent studies have explored the use of targeted reminders and financial incentives that have shown some promise in changing patient behaviors in other circumstances (Hasan et al., 2023). One non-experimental study found that 30 percent of patients returned unused opioids when provided with a cash incentive, regardless of distance traveled (Liu, et al., 2021). Another

experimental study found that patients were 7 percentage points more likely to return their unused opioid medication when they received reminder cards relative to a baseline return rate of 25 percent for the control group, even when both groups were already receiving a financial incentive (Aliory, et al., 2021). These findings are similar to those obtained when using financial incentives and reminders to affect other health behaviors such as weight loss. For example, one experimental study found that adding a reward program to an existing evidence-based weight loss program doubled average weight loss among the treatment group relative to the control group, even after the program and rewards had concluded (Finkelstein et. al, 2017).

Using a novel experimental design, we tested the relative effectiveness of several alternative incentives for returning unused opioids. We focused on an economically disadvantaged, largely Hispanic population receiving medical care at one of five community health centers located in a mid-sized city in Massachusetts[1] with one of the highest opioid overdose rates in the state as well as the nation.[2] Patients who were prescribed an opioid for an acute diagnosis such as surgery, injury, or acute pain were randomized across calendar days within each site into treatment and control groups. Patients in the treatment group were counseled by pharmacy staff according to a pre-specified protocol that provided information about the addictive nature of opioid medication, the potential for misuse, and how to safely return any unused medication. We further varied the intervention across locations using a text reminder, gift card, mail-back envelope, or provider consultation and examined whether these features increased the opioid return rate. Our primary outcome measure was the rate at which patients in the treatment group returned their unused medication relative to that of the control group. We also explored heterogeneous treatment effects across demographic groups and prescription characteristics.

Our randomized controlled trial allows us to explore questions that have previously been under-studied. First, does providing salient information about opioid medication and its safe disposal at the point of dispensing increase the likelihood that patients will return unused opioids

[1] Five-year estimates from the American Community Survey (2019-2023), show that the study population was 82.3 percent Hispanic or Latino and 43.7 percent foreign-born with 78.5 percent speaking a language other than English. The per capita income ($27,827) was roughly half that of the state ($56,284) and 34 percent lower than the U.S. ($43,829). The poverty rate (18.2 percent) was nearly twice that of the state (10.4 percent) and the U.S. as a whole (11.1 percent) (U.S. Census Bureau Quick Facts, n.d.).

[2] The Massachusetts Bureau of Substance Addiction Services Dashboard reports that the study population experienced 48.5 opioid-related overdose deaths per 100,000 population (age-adjusted) in 2023. In comparison the age-adjusted rate of opioid drug overdose deaths was 30.0 per 100,000 in Massachusetts and only 24.3 per 100,000 for the U.S. as a whole (Garnett and Miniño, 2025). Between 2013 and 2023, the opioid mortality rate in the study city consistently ranked in the top 10 among 351 cities and towns in Massachusetts with 430 residents dying of an opioid overdose during this period (Massachusetts Department of Public Health, various years).

compared to passively observing the pharmacy's medication return kiosk? Second, do other incentives (e.g., financial incentive, text reminders) or program features (e.g., mail-back envelope, provider consultation) additionally increase the return rate beyond just providing patients with information about how to return their medication safely? Third, how do the characteristics of patients (e.g., age, gender, language) or their prescription (e.g., medication type, amount) affect the likelihood of returning any unused opioid medication? Finally, is the return rate meaningful compared to the population?

Our experimental data yields several important, and in some ways surprising, results. First, treated patients were only 3.0 percentage points more likely to return their unused opioid medication compared to those in the control group. These largely null effects increased slightly when coupled with a financial incentive or text reminder yet remained small in magnitude. Second, the amount of medication prescribed for a given condition varied widely and surprisingly, patients who were prescribed larger amounts were less likely to return their medication, perhaps due to greater severity of the medical condition for which it was prescribed. Third, a handful of patients (N=4) declined to pick-up their opioid medication when the pharmacist notified them that they were receiving an opioid. This was surprising given that Massachusetts requires providers to discuss both the risks and the amount of any opioid medication with their patients when it is prescribed.[3] However, patients might not recall this notification if they are receiving a lot of medical information during their visit, plus potential language barriers could lead to miscommunication. Overall, our results suggest that while medication return programs are useful in removing unused opioids from a small number of households, they are unlikely to yield sizeable reductions in the supply of opioids for secondary use at the community level. Given these null results, other interventions aimed at reducing secondary use of opioids such as greater patient education, stricter limits on prescribing amounts, or mandatory prescription drug monitoring programs are likely to be more effective and efficient at reducing opioid use disorder, overdose, and mortality rates at the community level. In the meantime, given the popularity of drug take-back events and programs, learning about the circumstances under which they are both effective and ineffective can help policy makers direct

[3] Whenever a prescriber issues a prescription for a Schedule II opioid, they must: (1) consult with the patient regarding the quantity of the opioid prescribed and the patient's option to fill the prescription in a lesser quantity; and (2) inform the patient of the risks associated with the opioid being prescribed (Massachusetts Executive Office of Health and Human Services, 2016).

limited resources towards scaling efforts that have the potential to make meaningful progress on the opioid epidemic (Sacarny et al., 2016).

## I. Experimental Design, Data, and Methods

### *A. Experimental Design*

Our intervention targeted patients who were prescribed an opioid for an acute diagnosis such as surgery, injury, or acute pain for a supply of 14 days or less. Patients were randomized into treatment and control groups within each pharmacy site but across calendar days to avoid any bias in prescribing due to appointment or clinician scheduling. Patients who were prescribed opioid medication on a treatment day received an additional consultation with the pharmacist notifying them about the medication return program when they picked up their prescription. This additional consultation was offered in both English and Spanish and provided verbally as well as via a written notification card that the patient could keep. This notification included three key pieces of information: (1) that the medication was an opioid with the potential for addiction, (2) that patients may not need the full amount that was prescribed so they may have some medication left over, and (3) that the patient could return any unused medication by safely depositing it in the kiosk located in the lobby of the pharmacy (see Figure A1). Patients who were prescribed an opioid on a control day received no additional information beyond the usual pharmacist consultation given to all patients picking up medication, although they could passively observe that a medication return kiosk was available for use in the lobby of the pharmacy.

The initial kiosk return intervention was implemented between September 2019 and March 2020 and consisted of three main treatment arms implemented by pharmacy site (see Figure A2). The first was an information-only intervention where patients in the treatment group at three pharmacy locations received both the in-person consultation with the pharmacist and the notification card to take home (treatment arm 1). The other two treatment arms included the same information intervention as the first, but with either a text message reminder sent to patients at the end of each month to return any unused opioids to the pharmacy (treatment arm 2), or a financial incentive (but no text reminder) in the form of a $10 gift card if they returned

their medication to the in-person kiosk (treatment arm 3).[4] Whenever a patient returned medication to the pharmacy, the pharmacist would deposit the medication into the kiosk, collect some basic information about the amount and type of medication that was returned, have the patient print and sign their name in the return log, and dispense the gift card (if they were part of the third treatment arm).

Due to the COVID-19 pandemic, the intervention was suspended from March 2020 through June 2021 due to concern for patient safety and reduced capacity among pharmacy staff. During this period, we conducted qualitative interviews with patients in the treatment group to better understand the incentives and barriers related to returning opioid medication. Patients reported that the financial incentive was not a primary motivation for returning medication and that they would be more likely to dispose of their unused opioids if it were more convenient, rather than having to return to the pharmacy, or if the information came from their clinician, rather than the pharmacist.

In response to the first of these findings, we pivoted to a mail-back intervention from June 2021 to December 2021 that also included the text message reminder as a feature. Due to continued capacity constraints among the staff, this intervention was only implemented at one pharmacy site with the hope that, if successful, the intervention could be scaled-up across the other sites, reducing the need for pharmacists to handle kiosk returns. To test this, *any* patient receiving a prescription for acute opioid use was notified about the kiosk program during the consultation with the pharmacist, but patients in the treatment group were also given a mail-back envelope to dispose of their medication at their convenience (see Figure A3).

As a third intervention, the community health center recruited a group of Family Medicine clinicians at an affiliated hospital so that the notification could occur upstream during the patient visit, rather than at the pharmacy level. This third intervention was implemented from March 2022 to August 2022 and targeted patients who had undergone a cesarean section during childbirth and were prescribed an opioid upon discharge from the hospital. These patients were randomly assigned to treatment based on the two-week resident rotation cycle to ensure protocol fidelity. Treatment consisted of clinicians providing both the informational consultation and the

[4] The monetary amount of the gift card was carefully calibrated to sufficiently compensate patients for their time subject to Medicaid regulations (financial incentives are capped at $20 per year), so that a patient could return unused medication more than once. In addition, the Massachusetts Board of Pharmacy cautioned the center about offering too generous of a financial incentive due to concerns about promoting adverse behaviors such as taking too little medication or inadvertently encouraging patients to view their medication as a valuable commodity to sell on the black market.

mail-back envelope to patients so they could easily return any unused opioid medication postpartum (see Figure A4).

One challenge of implementing multiple interventions over time was variation in fidelity, which was tracked by pharmacy staff noting any deviations from each protocol in an error log. Before the initial kiosk protocol was launched in September 2019, the pharmacy staff received formal training on both the notification and return procedures resulting in 93 percent accuracy rate.[5] However, during the mail-back intervention from June through December 2021, the fidelity with which the treatment was administered dropped to 78 percent, due to the lack of staff capacity as the pharmacy re-opened post-COVID. In response, we intentionally planned to the clinician intervention to coincide with the two-week rotating medical resident schedule and be overseen by the obgyn surgical attending group, boosting the accuracy rate back to 93 percent. In terms of tracking returns, both the kiosk and mail-back return logs were kept with 100 percent accuracy due to strict Drug Enforcement Agency (DEA) protocols[6] for handling-controlled substances (see Figure A5).

### *B. Data*

Our analytical dataset includes information from pharmacy records, intervention error logs, and medication return logs maintained by the pharmacy staff. The pharmacy records include detailed information about the patient (e.g., date of birth, gender, race, language spoken, marital status, and family size) and their opioid prescription (e.g., date dispensed, pharmacy location, type and quantity of medication). The intervention logs record whether the prescription was dispensed on a treatment day and if so, whether the patient was appropriately notified. The return logs record the patient's name as well as the return date, amount returned, pharmacy location, and how they heard about the program.

Since the randomization occurred by pharmacy location across the different interventions and treatment arms, we test for balance across the treatment and control groups for each intervention and also by each treatment arm separately. For example, Table 1 confirms that there are few, if any differences, between the treatment and control groups for the overall kiosk

[5] See Exhibit A1 for the pharmacy staff research protocol training quiz.

[6] See code of Federal Regulations, Title 21, Chapter 2, Part 1317 relating to opioid disposal here: https://www.ecfr.gov/current/title-21/chapter-II/part-1317.

intervention.[7] The average age across both treatment and control groups is around 50 years old, with about 60 percent of patients recorded as female, a little more than half of patients identified as White, and roughly 70 percent noted as speaking Spanish. About one-third of patients were married with an average family size of approximately 2.5 members, confirming the potential for opioids to be accessed by other family members. The average number of pills prescribed was around 18 and the mean supply was about 5 days. More than 60% of prescriptions were classified as Schedule II (strong) Overall, only one characteristic (Black) was marginally statistically significant, which is to be expected when testing across 22 different characteristics.[8]

[Insert Table 1 here]

Table 1 also shows that patients in the treatment group were significantly more likely to return their medication than those in the control group, although the magnitude of the effect is quite small (3.0 percentage points). To understand why the take-up rate was lower than anticipated among the treatment group, during the spring of 2021 while the program was suspended during the COVID-19 disruption we surveyed pharmacy staff and interviewed a small sample of patients in the treatment group to uncover any unforeseen barriers or unintended consequences. A total of 22 staff responded to the survey (a roughly 50 percent response rate) of whom about 80% were Registered Pharmacists, the majority had at least 10 years of experience, and about half worked in the location that implemented the financial incentive arm (see Table A1). Topics covered their experiences with implementing the return program in terms of patient awareness, understanding, and concerns (see Exhibit A2). Patients in the treatment group were contacted via text and offered a $25 gift card to compensate them for a 15 minute phone interview with community health center staff. A total of 10 patients were interviewed that were largely representative of the treatment group (see Table A2). Topics included their experiences with care at the community health center and pharmacy, details about the opioid prescription that they had

[7] Tables B1-B3 show balance across each treatment arm (e.g., information only, text reminder, financial incentive) within the kiosk intervention.

[8] We also show that there is no significant difference across the two groups in the distribution across race, language, and marital status categories using a chi-square test.

received, whether or not they returned any unused medication and their reasons for doing so or not (see Exhibit A3).

### *C. Empirical Strategy*

We separately test the effectiveness of each intervention (e.g., kiosk, mail-back, and clinician involvement) on medication return behavior using the following equation:

(1) $$Return_{\mathrm{i}} = \alpha_0 + \beta_1 Treated_i + \gamma_1 X_i + \varepsilon_i$$

where $Treated * \mathrm{Arm}_j$ (j=1,2, or 3) is an indicator for receiving the intervention in one of the three treatment arms. The coefficient $\delta_{\mathrm{j}}$ on the interaction term $Treated_i * \mathrm{Arm}_j$ captures the impact of the treatment group relative to the control group within each treatment arm (e.g., information-only, text message reminder or financial incentive). We also test whether the coefficients across each pairwise set of treatment arms is statistically significant.

Next, we test for heterogeneity across treatment arms within the kiosk intervention (e.g., information-only versus information plus financial incentive and/or text message reminder) using the fully saturated model in Equation (2):

(2) $$Return_{ia} = \alpha_0 + \delta_1 Treated_i * Arm_1 + \delta_2 Treated_i * \mathrm{Arm}_2 + \delta_3 Treated_i * Arm_3 + \gamma_2 X_i + \varepsilon_{i2}$$

where $Treated * \mathrm{Arm}_j$ (j=1,2, or 3) is an indicator for receiving the intervention in one of the three treatment arms. The coefficient $\delta_{\mathrm{j}}$ on the interaction term $Treated_i * \mathrm{Arm}_j$ captures the impact of the treatment group relative to the control group within each treatment arm (e.g., information-only, text message reminder or financial incentive). We also test whether the coefficients across each pairwise set of treatment arms is statistically significant.

Finally, we test for heterogenous effects across patient sub-groups where we might expect to see a differential impact (e.g., patients who are non-native English speakers or received differing

quantities of opioids). We modify equation (1) to replace the main program effect with a fully specified set of interaction terms between the $Treated_i$ dummy and the subgroup of interest. For example, to test whether the return program has a differential impact on Spanish speakers, we estimate equation 3 as follows:

(3) $$Return_{ig} = \alpha_0 + \theta_1 Treated_i * SpanishSpeaker_g + \theta_2 Treated_i * NonSpanishSpeaker_g + \gamma_3 X_i + \varepsilon_i$$

We then test whether the difference between $\theta_1$ and $\theta_2$ is statistically significant to determine whether the program exhibits heterogeneous treatment effects for Spanish-speaking patients. We repeat this exercise separately for each subgroup of interest.

## I. Results

### *A. Kiosk Intervention*

Across all five locations combined there were 1,461 eligible patients who received an acute opioid prescription over the six-month period from September 2019 through March 2020, with 687 patients randomly assigned to the treatment group and notified of the program. Of those, a total of 18 patients returned medication yielding a differential return rate of 3.0 percent among the treatment group relative to the control group. Table 2 reports the coefficients from Equation1, sequentially adding in other explanatory variables which do not substantially change the magnitude nor significance of the coefficient. None of the control variables themselves are significant, confirming that the randomization was indeed balanced and underscoring the robust, albeit small, treatment effect.

[Insert Table 2 here.]

While these results were promising relative to the very small return rate of 0.3 percent observed in prior experimental studies, the overall return rate for our intervention was considerably lower than the 30 percent that had been achieved in non-experimental settings using

an additional financial incentive. To explore the added effectiveness of different incentive structures, Table 3 reports the estimates from Equation 2 comparing the impacts of the information-only, text message, and financial incentive treatment arms. Patients in the treatment group who received information plus the text message reminder were roughly 3.8 percentage points more likely to return their opioid medication compared to patients in the control group at that pharmacy location. In comparison, patients receiving the financial incentive were 4.1 percentage points more likely than the control group to bring back their opioid medication, although the treatment effect is not statistically different from the estimated impact of the text message reminder. Yet both the text message reminder and financial incentive yielded impacts that were significantly greater than the information-only arm (1.1 percentage points). However, the overall effect size remains relatively small across all three of the treatment arms, which suggests that offering a text message reminder or modest financial incentive provides a relatively small additional motivation for patients who were not already predisposed towards returning their unused opioid medication. Moreover, the lack of improved effectiveness of the financial incentive over the text message reminder implies that it may not be the most efficient method once the added cost of the $10 gift card is considered.

[Insert Table 3 here.]

### *B. Mail-back Intervention*

In March of 2020, the kiosk intervention was suspended due to concerns about patient safety and staff capacity during the COVID-19 pandemic. We took this interruption as an opportunity to collect qualitative data to understand why the take-up rate was lower than anticipated among the treatment group. Patient interviews revealed that some individuals did not return their medication because they had used all of the amount that was prescribed to them. This finding aligns with state law imposing a maximum seven-day supply on first-time prescriptions, which would likely be most binding on patients who were receiving a prescription for acute use.[9]

[9] As of March 2016, Massachusetts established a maximum seven-day supply on prescriptions opioids when issued to an adult for the first time or to minors at any time. A prescriber may issue a prescription for more than a seven-day supply of an opioid to adult or minor patients if, in the prescriber's medical judgment, a greater supply is necessary to treat an acute medical condition, chronic pain, pain associated with a cancer diagnosis or for palliative care. In such a case, the condition must be documented in the patient's medical record and the prescriber must indicate that a non-opioid alternative was not appropriate to address the medical condition. See https://www.mass.gov/news/update-for-prescribers-new-law-regarding-opioids#:~:text=A%20prescriber%20may%20issue%20a,diagnosis%20or%20for%20palliative%20care for more information.

Yet, prescribing restrictions are not likely to fully account for the low medication return rate that we observed during the kiosk intervention. Claims data confirm that roughly 8.0 percent of patients received a prescription where the days supplied was greater than 7 days. Moreover, among those patients who did return their opioid medication, the kiosk return logs show that just over half of patients reported that the primary reason was that they did not need to take all of the medication (See Figure A6). Our interviews also confirmed that among those offered the financial incentive, patients cited not needing the medication anymore, experiencing side effects, and concern that family and friends might take the medication as their primary motivation for returning it to the pharmacy. Finally, the return logs also revealed that among patients who did return their medication, most of them did so within one month after the prescription date. This suggests that the hazard rate of returning any unused medication likely decreases quite rapidly over time, although this "return window" could potentially be extended with additional intervention given patients also reported the text message was a helpful reminder.

In response to these qualitative insights, as well as the need to reduce in-person visits to the community health centers, we chose to pivot the intervention and test whether using a mail-back envelope, rather than the kiosk disposal, would boost the return rate.[10] Allowing patients to return their medication by mail could reduce transportation barriers and increase convenience while also improving patient safety. Thus, the treatment group now received both the information along with a mailing envelope from the pharmacist to return any unused medication to the pharmacy. The control group received only the information and notification card to return any unused medication to the pharmacy via the kiosk.[11] Both groups were sent text reminders at the end of the month to return their medication, but no financial incentives were used.

Between June and December of 2021, 149 eligible patients received an opioid prescription, of which 116 were provided information about returning their opioid medication (treatment and control) according to the protocol (78 percent fidelity). Table 4 shows that of the 45 patients in the treatment group who were notified about using the mail-back envelope, a total of 4 individuals returned their opioid medication (8.9 percent return rate) compared to only 2 out of 71 patients in the control group that were notified about the kiosk (2.8 percent return rate).

[10] Note that this intervention was not part of the original study design but was implemented in response to the disruption of the research protocol caused by COVID-19 pandemic. We did seek approval from JPAL in a revised research protocol before re-launching the program in spring 2022.

[11] See Table B.4 for balance check of the mail-back intervention.

Although these results suggest that the mailing envelope improved the return rate, our small sample size is not well-powered to detect whether there was a statistically significant increase over the kiosk disposal method. Regardless, the overall return differential was still only one-quarter of that achieved in non-experimental settings, again confirming the difficulty of incentivizing patients to return their opioid medication, despite removing some of the barriers that are frequently cited in the literature.

[Insert Table 4 here.]

### *C. Clinician Intervention*

From the interviews conducted by the community health center staff, patients also reported they would be more willing to return their opioid medication if their clinician notified them instead of the pharmacist. To test whether this would significantly increase the return rate, we worked with an affiliated team of Family Medicine clinicians to counsel their c-section patients who were prescribed an opioid, using the same standardized script, notification card, and mail-back envelope as before. Treatment occurred on a two-week rotation that coincided with the residency schedule and on the off-cycles the control group received no additional counseling. Of the 47 eligible patients that had received an opioid prescription on a treatment day, 44 had been notified using the mail-back intervention according to protocol (93 percent fidelity). Of those who were notified, a total of 2 patients returned their opioid medication (4.3 percent return rate) compared to zero patients in the control group.[12] Thus, while clinician notification using the mail-back envelope was on par with that of the kiosk intervention, it did not increase the opioid medication return rate compared to the pharmacist notification when using the same mail-back return method.

[12] Despite the low number of patients observed, the sample was fairly homogeneous in terms of gender (all female), diagnosis (c-section), and days supplied (3-5 days). See Table B.5 for the formal balance check of the clinician intervention.

### *D. Exploring Heterogeneity across Patients*

Prior literature shows that patient demographic characteristics as well as the amount and type of medication prescribed are systematically correlated with rates of opioid use disorder and overdose. For example, one of the most commonly cited issues regarding opioid prevention, treatment, and recovery strategies for Hispanic/Latino communities is the need for bilingual providers and materials in the patients' native language (SAMHSA 2020). Other evidence shows increased risk for opioid use disorder and overdose that appears to rise with opioid dosage, without a clear threshold below which there is no risk (Chou et al., 2020). As a result, we might expect that non-native English speakers or patients receiving higher dosages or days supplied would be more likely to return their unused medication when provided with salient information, especially when coupled with any additional incentives.

Table 5 formally tests for heterogeneity in treatment outcomes across patients in the financial incentive arm of the kiosk intervention using equation (3). As expected, among patients in our sample who returned their medication, there is a greater percentage of Spanish speakers who returned their opioid medication, possibly because the pharmacist consultation and notification cards were also provided in Spanish, overcoming one potential barrier. Surprisingly, those who returned their medication had a *lower* days' supply and quantity, suggesting that perhaps their initial need for opioid medication (e.g., medical condition, pain threshold) was lower than those who did not return their medication. Controlling for other patient demographics (e.g., age, gender, race, family size) does little to change these results.

[Insert Table 5 here.]

## II. Conclusion

Over the past decade, public health officials have sought to reduce both the demand for and the supply of opioids in an effort to stem the rising tide of overdoses and deaths within communities, particularly those that are economically disadvantaged and where the opioid epidemic has taken a disproportionate toll. Although "take-back" days and medication return programs have generated increased interest in recent years, to date little is known about the take-up rates of such programs among patients or even what types of medication are returned through these initiatives. Understanding whether opioid medication return programs work and for whom, as well as which

program features can make them more effective and cost efficient, is important before considering implementation on a larger scale.

This paper provides some of the first causal evidence regarding the implementation of an opioid medication return program within an economically disadvantaged, largely immigrant community with one of the highest opioid overdose rates in the nation. Using a randomized control trial, we found that patients who were informed about how to safely dispose of their medication were 3.0 percentage points more likely to return their unused opioid medication to the pharmacy than those in the control group. This significant impact increased slightly when coupled with a text reminder or financial incentive yet remained small in magnitude.

Given the low return rate relative to non-experimental studies, it seems challenging to incentivize people to bring back unused opioid medication who would not have otherwise, despite the risk of misuse by themselves or others in their household. Even when offering a modest financial incentive among an economically disadvantaged population, we were unable to produce much of a response to return unused opioid medication. Although it could be that our financial incentive was too low, the dollar amount was capped to adhere to Medicaid regulations and avoid incentivizing patients not to take the medication if it was needed. In addition, our patient interviews revealed that money was not the sole or even primary motivator for returning medication. Most patients who returned their medication reported they were concerned about themselves or others becoming addicted, perhaps explaining why providing a text message reminder was equally as effective as our modest financial incentive. Although providing a mail-back envelope more than doubled the medication return rate, these effects were imprecisely estimated so we cannot conclude that increasing convenience is more effective than providing a financial incentive. Either way, the effects are small.

Surprisingly, the amount of opioid medication prescribed for a given condition varied widely, with patients who received smaller quantities being more likely to return their medication, perhaps due to lower need given the medical condition for which it was prescribed. Moreover, four patients in the treatment group declined their medication when the pharmacist notified them that it was an opioid. This could be due to language barriers, lack of sufficient explanation from their clinician, or even just that many opioid medications have unrecognizable names. Indeed, Spanish speaking patients were more likely to return their medication, perhaps because the intervention was explicitly delivered both verbally and in writing using both Spanish and

English. These findings suggests that improved patient education and up-front notification could play an important role in reducing unnecessary opioid use.

Finally, adding clinician involvement did not increase the return rate. Given the difficulty in recruiting a clinician team that had the capacity to notify patients in addition to their regular standard of care, it seems that this type of intervention would be difficult to bring to scale even if it produced sizeable impacts. Given the comparative strength of the research evidence regarding the effectiveness of initial prescribing limits and mandatory prescription drug monitoring programs, our results suggest that continuing to educate more providers regarding these best practices would be a more efficient use of clinician resources in combatting the opioid crisis.

Overall, our results suggest that while medication return programs can be useful in removing opioids from a small number of households, they are unlikely to yield sizeable reductions in opioid overdose and deaths within a community. However, there could be some conditions under which these programs might be more effective which we were unable to test given our experimental setting, such as rural areas with sparse health care delivery systems and/or treatment sites such as hospitals that dispense a high number of opioid prescriptions for acute use. Until further research evidence can be generated, it would appear that continuing proven approaches to reducing the demand for and supply of opioids within communities such as increasing patient education, setting stricter limits on the amount of medication that is prescribed, or expanding the use of mandatory prescription drug monitoring programs are likely to be more effective and efficient in yielding a meaningful impact on the nation's ongoing opioid crisis.

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TABLE 1— BALANCE TEST FOR KIOSK INTERVENTION

ALL THREE TREATMENT ARMS COMBINED

| | Treatment Group | | Control Group | | Treatment - Control | | |
|---|---|---|---|---|---|---|---|
| | Mean (1) | SE (2) | Mean (3) | SE (4) | Diff. (5) | P-value (6) | Chi-Square (7) |
| Mean Age (years) | 50.17 | (0.64) | 50.55 | (0.62) | -0.38 | 0.67 | |
| Percent Female | 0.59 | (0.02) | 0.62 | (0.02) | -0.03 | 0.27 | |
| Percent White | 0.53 | (0.02) | 0.52 | (0.02) | 0.02 | 0.48 | 0.27 |
| Percent Black or African American | 0.14 | (0.01) | 0.18 | (0.01) | -0.04 | 0.05* | |
| Percent Dominican | 0.14 | (0.01) | 0.14 | (0.01) | 0.00 | 0.92 | |
| Percent Other Race | 0.07 | (0.01) | 0.07 | (0.01) | -0.00 | 0.78 | |
| Percent Race Unknown | 0.11 | (0.01) | 0.09 | (0.01) | 0.02 | 0.17 | |
| Percent English Speaking | 0.22 | (0.02) | 0.19 | (0.01) | 0.03 | 0.18 | 0.36 |
| Percent Spanish Speaking | 0.67 | (0.02) | 0.71 | (0.02) | -0.04 | 0.11 | |
| Percent Other Language | 0.01 | (0.00) | 0.00 | (0.00) | 0.00 | 0.33 | |
| Percent Language Unknown | 0.11 | (0.01) | 0.10 | (0.01) | 0.01 | 0.72 | |
| Percent Single | 0.52 | (0.02) | 0.50 | (0.02) | 0.02 | 0.37 | 0.72 |
| Percent Married | 0.30 | (0.02) | 0.32 | (0.02) | -0.02 | 0.32 | |
| Percent Divorced/Widowed/Separated | 0.13 | (0.01) | 0.12 | (0.01) | 0.01 | 0.75 | |
| Percent Marital Status Unknown | 0.05 | (0.01) | 0.05 | (0.01) | -0.00 | 0.68 | |
| Mean Family Size | 2.47 | (0.06) | 2.55 | (0.06) | -0.07 | 0.40 | |
| Percent Family Size Unknown | 0.11 | (0.01) | 0.10 | (0.01) | 0.01 | 0.53 | |
| Quantity Supplied (number of pills) | 18.95 | (0.70) | 18.16 | (0.51) | 0.80 | 0.35 | |
| Days Supply (number of days) | 4.80 | (0.10) | 4.61 | (0.10) | 0.19 | 0.20 | |
| Percent Opioid Schedule II (strong) | 0.61 | (0.02) | 0.65 | (0.02) | -0.04 | 0.13 | 0.15 |
| Percent Opioid Schedule III (moderate) | 0.18 | (0.01) | 0.16 | (0.01) | 0.02 | 0.22 | |
| Percent Opioid Schedule IV and V (weak) | 0.21 | (0.02) | 0.19 | (0.01) | 0.01 | 0.49 | |
| Percent Returning Medication | 0.03 | (0.01) | 0.00 | (0.00) | 0.03 | 0.00*** | |
| Number of Observations | 687 | | 774 | | 1461 | | |

*Source:* Authors' calculations using data provided by the community health center.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 2— IMPACT OF KIOSK INTERVENTION ON OPIOID MEDICATION RETURN RATES

ALL THREE TREATMENT ARMS COMBINED

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Treated in Any Location | 0.029*** | 0.029*** | 0.029*** | 0.029*** | 0.030*** | 0.030*** | 0.030*** |
| | (0.006) | (0.006) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| Mean Age (years) | | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 |
| | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Percent Female | | 0.003 | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 |
| | | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| Percent Black or African American | | | 0.015 | 0.014 | 0.013 | 0.013 | 0.013 |
| | | | (0.010) | (0.010) | (0.010) | (0.010) | (0.010) |
| Percent Dominican | | | 0.011 | 0.009 | 0.008 | 0.009 | 0.008 |
| | | | (0.010) | (0.010) | (0.011) | (0.011) | (0.011) |
| Percent Other Race | | | 0.012 | 0.008 | 0.006 | 0.007 | 0.007 |
| | | | (0.014) | (0.015) | (0.015) | (0.015) | (0.014) |
| Percent Race Unknown | | | 0.012 | 0.009 | 0.022 | 0.023 | 0.022 |
| | | | (0.012) | (0.009) | (0.015) | (0.015) | (0.015) |
| Percent Spanish Speaking | | | | 0.011** | 0.010* | 0.009 | 0.009 |
| | | | | (0.006) | (0.006) | (0.006) | (0.006) |
| Percent Other Language | | | | 0.158 | 0.158 | 0.150 | 0.148 |
| | | | | (0.153) | (0.151) | (0.152) | (0.153) |
| Percent Language Unknown | | | | 0.012* | 0.023* | 0.023** | 0.024** |
| | | | | (0.007) | (0.012) | (0.012) | (0.012) |
| Percent Married | | | | | 0.015* | 0.014* | 0.015** |
| | | | | | (0.008) | (0.008) | (0.008) |
| Percent Divorced/Widowed/Separated | | | | | 0.011 | 0.012 | 0.013 |
| | | | | | (0.011) | (0.011) | (0.011) |
| Percent Marital Status Unknown | | | | | 0.010 | 0.007 | 0.006 |
| | | | | | (0.021) | (0.021) | (0.021) |
| Mean Family Size | | | | | -0.000** | -0.000** | -0.000** |
| | | | | | (0.000) | (0.000) | (0.000) |
| Quantity Supplied (number of pills) | | | | | | -0.000 | -0.000 |
| | | | | | | (0.000) | (0.000) |
| Days Supply (number of days) | | | | | | -0.003** | -0.002* |
| | | | | | | (0.001) | (0.001) |
| Percent Opioid Schedule II (strong) | | | | | | | 0.005 |
| | | | | | | | (0.005) |
| Percent Opioid Schedule III (moderate) | | | | | | | 0.024** |
| | | | | | | | (0.011) |
| Observations | 1461 | 1461 | 1461 | 1461 | 1461 | 1461 | 1461 |
| $R^2$ | 0.016 | 0.016 | 0.019 | 0.027 | 0.036 | 0.039 | 0.044 |

*Source:* Authors' calculations using data provided by the community health center.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 3—TESTING HETEROGENEITY ACROSS TREATMENT ARMS FOR THE KIOSK INTERVENTION

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Treated at all (in any location) | 0.030*** | 0.030*** | | |
| | (0.006) | (0.006) | | |
| Treated at all* Information Only | | | 0.012* | 0.011 |
| | | | (0.007) | (0.008) |
| Treated at all *Text Reminder | | | 0.035*** | 0.038*** |
| | | | (0.015) | (0.011) |
| Treated at all *Financial Incentive | | | 0.042*** | 0.041*** |
| | | | (0.012) | (0.008) |
| Controls | | | | |
| Location dummies | Yes | Yes | No | No |
| Age | No | Yes | No | Yes |
| Gender dummies | No | Yes | No | Yes |
| Race dummies | No | Yes | No | Yes |
| Language dummies | No | Yes | No | Yes |
| Marital Status dummies | No | Yes | No | Yes |
| Number of observations | 1461 | 1461 | 1461 | 1461 |
| R-squared | 0.02 | 0.05 | 0.022 | 0.051 |

*Source:* Authors' calculations using data supplied by the community health center.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 4—TESTING THE IMPACT OF THE MAIL-BACK AND CLINICIAN INTERVENTIONS

ON THE OPIOID MEDICATION RETURN RATE

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| | Treatment | | Control | | Difference | |
| | Pharmacy Notification and Mail-back Envelope | | Pharmacy Notification and Kiosk Return | | Treatment - Control | |
| Panel A. Mail-back intervention | Number | Percent | Number | Percent | Percentage Points | p-value |
| Patients receiving a prescription for 14 days or less | 58 | 100.0% | 91 | 100.0% | 0.0 | |
| Notified according to protocol | 45 | 77.6% | 71 | 78.0% | -0.4 | 0.894 |
| Returned medication as a share of total | 4 | 6.9% | 2 | 2.2% | 4.7 | 0.315 |
| Returned medication as a share of notified | 4 | 8.9% | 2 | 2.8% | 6.1 | 0.308 |
| | Clinician Notification and Mail-back Envelope | | Pharmacy Notification and Kiosk Return | | Treatment - Control | |
| Panel B. Clinician intervention | Number | Percent | Number | Percent | Percentage Points | p-value |
| Patients receiving a prescription for 14 days or less | 47 | 100.0% | 26 | 100.0% | 0.0 | |
| Notified according to protocol | 44 | 93.6% | 24 | 92.3% | 1.3 | 0.8349 |
| Returned medication as a share of total | 2 | 4.3% | 0 | 0.0% | 4.3 | 0.2927 |
| Returned medication as a share of notified | 2 | 4.3% | 0 | 0.0% | 4.3 | 0.2783 |

*Source:* Authors' calculations using data supplied by the community health center.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 5—TESTING HETEROGENEITY ACROSS PATIENT GROUPS

FINANCIAL INCENTIVE ARM OF KIOSK INTERVENTION

| | Spanish Speaking | | Days Supplied <4 Days | | Quantity<10 Pills | | Strength= Schedule II or III | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Treated * In Group | 0.039*** | 0.039*** | 0.083*** | 0.074*** | 0.091** | 0.080** | 0.047*** | 0.041*** |
| | (0.014) | (0.015) | (0.024) | (0.022) | (0.039) | (0.036) | (0.014) | (0.012) |
| Treated * Out of Group | 0.046** | 0.038** | 0.006 | 0.006 | 0.030*** | 0.028*** | 0.018 | 0.032* |
| | (0.020) | (0.018) | (0.006) | (0.007) | (0.011) | (0.011) | (0.017) | (0.019) |
| Difference | -0.007 | 0.001 | 0.077 | 0.069 | 0.061 | 0.052 | 0.029 | 0.009 |
| p-value | 0.78 | 0.94 | 0.002** | 0.003** | 0.13 | 0.16 | 0.18 | 0.65 |
| Controlling for: | | | | | | | | |
| Age | No | Yes | No | Yes | No | Yes | No | Yes |
| Gender | No | Yes | No | Yes | No | Yes | No | Yes |
| Race | No | Yes | No | Yes | No | Yes | No | Yes |
| Language | No | No | No | Yes | No | Yes | No | Yes |
| Marital status | No | Yes | No | Yes | No | Yes | No | Yes |
| Number of observations | 665 | 665 | 665 | 665 | 665 | 665 | 665 | 665 |
| R-squared | 0.024 | 0.093 | 0.06 | 0.114 | 0.038 | 0.103 | 0.027 | 0.081 |

*Source:* Authors' calculations using data supplied by the community health center.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

# Supplementary Materials

## A. Experimental Design and Implementation

Our intervention targeted patients who were prescribed opioids for an acute diagnosis such as surgery, injury or acute pain living in an economically disadvantaged, and largely non-English speaking community. Patients with prescriptions for acute use were identified as having an opioid prescription for a supply of 14 days or less. Patients were randomized into the treatment and control groups within each pharmacy site but across calendar days to avoid any bias in prescribing due to appointment or clinician scheduling. Patients who were prescribed opioid medication on a treatment day, received an additional consultation with the pharmacist notifying them about the program when they picked up their prescription. This additional consultation was offered in both English and Spanish and included three key pieces of information: (1) that the patient was receiving an opioid and that opioids can be addictive, (2) that unlike other medications, patients may not need to take all of the pills that were prescribed so they may have some medication left over, and (3) that the patient could return any unused medication to pharmacy by safely depositing it in the take-back kiosk in the lobby of the pharmacy. Patients that were prescribed opioid medication on a control day received no additional information beyond the usual pharmacist consultation regarding any questions about taking their medication.

The initial kiosk return intervention was implemented between September 2019 and March 2020 and consisted of three main treatment arms implemented by pharmacy site. The first treatment arm was an information-only intervention where patients in the treatment group at three of the sites were notified of the program with both an in-person consultation with the pharmacist and a notification card to take home with the same information in both English and Spanish. The second treatment arm included the same information as the first treatment arm as well as a text message reminder sent to patients at the end of each month to return any unused opioids to the pharmacy. The third treatment arm included the same information as the first treatment arm provided a financial incentive (but no text reminder) in the form of a $10 gift card if they returned their medication to the in-person kiosk. Whenever a patient returned medication to the pharmacy, the pharmacist would deposit the medication into the kiosk, collect some basic information about the amount and type of medication that was returned, have the patient print and sign their name in the return log, and dispense the gift card (if they were part of the third treatment arm).

In response to the onset of the COVID-19 pandemic, the intervention was suspended from March 2020 through June 2021 out of concern for patient safety and reduced capacity among pharmacy staff. During this period, we conducted qualitative interview with patients in the treatment group to better understand the incentives and barriers to returning medication. Patients reported that the gift card was not their primary motivation for returning medication and that they would be more likely to dispose of their unused opioids if it were more convenient, rather than returning it to the pharmacy, or if the consultation about the program came from their clinician, rather than the pharmacist.

In response to the first of these findings, we pivoted to a second intervention from June 2021 to December 2021 that dropped the financial incentive and applied this cost savings to purchase mail-back envelopes for patients to return medication, while also keeping the text message reminder as a feature. Due to continued capacity constraints among the pharmacy staff, this intervention was only implemented at one pharmacy site with the hope that, if successful, these changes would make the intervention easier to scale-up at the other sites by reducing the need for pharmacists to track returns and distribute gift cards. To test this, pharmacists notified **any** patient receiving a prescription for acute opioid use about the kiosk program during the consultation when they received their medication, but now also provided patients in the treatment group with the mail-back envelope to dispose of their medication at their convenience rather than returning to the pharmacy

In the meantime, our partners at the center worked to recruit a group of physicians who would be willing to participate in the experiment so that the notification could occur at the clinician level, thereby bypassing the pharmacy altogether. This yielded a third intervention from March 2022 to August 2022 where a team of the center affiliated  Family Medicine clinicians at a hospital affiliated with the center agreed to counsel patients about the program and provide them with a mail-back envelope to return any unused opioid medication postpartum. Patients who had undergone a cesarean section that were prescribed an opioid upon discharge from the hospital were randomly assigned to treatment based on the two-week physician rotation cycle to ensure protocol fidelity.

**Exhibit A1. Training Quiz For Health Center Pharmacy Staff**

J-PAL
ABDUL LATIF JAMEEL POVERTY ACTION LAB
NORTH AMERICA

Question: Patient X has brought back the pictured medication bottle, and asked to put it into the kiosk. They report that it is X drug. How should Pharmacist Y estimate the type of medication and the amount of medication left?

A. By asking the patient how much they took and subtracting from the label on the bottle
B. The pharmacist opens the prescription bottle pours the medications out, and visually verifies and counts the number of pills
**C. Patient opens the prescription bottle and the pharmacist visually verifies the medication and the approximate number of pills left**
D. The pharmacist opens the prescription bottle, visually verifies the medication, and having the patient count the number of medications left

Question: Patient X comes in for their prescription pick-up, which pharmacist Y has verified the day before. How will the pharmacy technician know if a pharmacist needs to counsel the patient about the kiosks?

A. Based on the duration and type of prescription
**B. Based on whether a card has been stapled to the prescription bag and a stamp that says "See RPh"**
C. Based on the day that Patient X has come in

Question: People who receive opioid prescriptions for ____ ____ days duration are eligible for the study. *Note that this does NOT mean they necessarily receive the information/intervention.

**A. 14 days or less**
B. Greater than 14
C. Less than 10
D. Greater than 10
E. Less than 30
F. Greater than 30

Question: For this week, the treatment days are Monday 5/6/19, Wednesday 5/8/19, and Friday 5/10/19 as marked on the calendar. Patient X has come to fill their 14-day prescription of hydrocodone-acetaminophen after an inguinal hernia repair on Tuesday 5/7/19.

Patient comes to pick up the prescription today on Wednesday 5/8/19. Pharmacist Y notices that today is a "treatment day" as marked on the calendar in the pharmacy. They also notice that there is not an information card stapled to the patient's packet. Should Pharmacist Y give Patient X information about the return kiosks?

A. Yes, because it is a treatment day on the calendar.
B. Yes, because the patient meets the criteria for having a short-term opioid prescription.
**C. No, because there is no card stapled to the bag since the patient's medication was not filled on a treatment day.**
D. No, because the patient does not meet the criteria for having a short-term opioid prescription.

Question: Patient X's doctor has just changed their medication regimen, and Patient X has some extra nifedipine in their bottle. They see the kiosk, and ask to return the extra medication to the kiosk. What do you do?

**A. Advise patient to discard the medication at a community medication disposal site**
B. Take the bottle, put it in the kiosk, and make sure to mark on the log that this was a non-opioid return.
C. Refuse the bottle and tell the patient to put it in their trash can.

Question: It is a very busy day in the pharmacy. Patient X comes in for a 10-day prescription of hydrocodone-acetaminophen. You verify the prescription and patient picks it up. A couple of hours lateryou realize that you forgot whether they had an information card, and you did not talk with them about returning the medications. What do you do?

A. Call them to give information about the kiosks.
B. Do nothing.
**C. Log it in the patient tracker that you are uncertain if a card was stapled to the prescription bag.**

## Exhibit A2. Survey of Health Center Pharmacy Staff

Northeastern University

### Community Opioid Bring Back Program

We would like to hear about your experiences with notifying patients about the opportunity to return unused opioid medication to the pharmacy. Please circle the answers that best represent your point of view. Feel free to write notes in the boxes. We will collect the survey and aggregate the responses to maintain anonymity and confidentiality.

| | | | | | | |
|---|---|---|---|---|---|---|
| Which pharmacy location do you work in? | Haverhill Street | Park Street/ North | Essex Street/ West | Winthrop Ave/South | | Pelham Street |
| How many years of experience do you have as a pharmacist? | Less than 1 year | 1-2 years | 3-5 years | 6-10 years | | More than 10 years |
| What is your current position at GLFHC? | Pharmacy Tech | Registered Pharmacist (RPH) | | Manager | | |
| How many patients did you notify about the opioid bring back program? | None | 1-10 patients | 11-24 patients | 25-50 patients | 50-100 patients | More than 100 patients |
| What percentage of patients did you need to notify in a language other than English? | None | Less than 25% | 25-50% | 51-75% | | 76-100% |
| How often did patients ask questions after being notified about the program? | Never | Rarely | Sometimes | Frequently | | Most of the time |
| How often did patients indicate that they were unaware that they had been prescribed an opioid by their provider? | Never | Rarely | Sometimes | Frequently | | Most of the time |
| What percentage of patients appeared to have been prescribed an opioid in the past? | None | Less than 25% | 25-50% | 51-75% | | 76-100% |
| How did patients react to being told that the medication they were receiving can be addictive? | No reaction | Somewhat surprised | Surprised | Shocked | | Alarmed |
| In general, to what degree do you think patients understood that they were being asked to return any unused medication? | Did not seem to understand at all | Some understanding | Understood the basic idea | Understood completely | | |

Northeastern University

| | | | | | |
|---|---|---|---|---|---|
| In general, to what degree did patients seem receptive to the program? | Did not seem receptive at all | Somewhat receptive | Receptive | | Very receptive |
| Were there any problems with notifying patients about the program that we should be aware of? (Please feel free to comment in the space to the right) | | | | | |
| How many patients did you help to return their medication when they brought it back to the pharmacy? | None | 1-2 patients | 3-5 patients | 6-10 patients | More than 10 patients |
| To what degree were patients concerned about giving their name in exchange for receiving the gift card (Haverhill Street only)? | No reaction | Somewhat concerned | Concerned | Very Concerned | Refused |
| To what degree were patients concerned about having the pharmacist visually inspect the medication? | No reaction | Somewhat concerned | Concerned | Very Concerned | Refused |
| Were there any problems with patients returning medication that we should be aware of? (Please feel free to comment in the space to the right) | | | | | |

## Exhibit A3. Interview Protocol for Patients in the Kiosk Intervention Treatment Group

**INTERVIEW PROTOCOL**

**Objectives:**

- DETERMINE WILLINGNESS TO BRING BACK PAIN VERUS OTHER MEDICATION
- IDENTIFY BARRIERS TO BRINGING BACK PAIN MEDICATION
- ASSESS INDIVIDUAL KNOWLEDGE ABOUT PAIN MEDICATION
- IDENTIFY POTENTIAL CHANGES THAT CAN BE MADE TO THE INTERVENTION

**1. Welcome and introduction to the topic**

Thanks for taking the time to join us to talk about your experiences with pain medication and the community health center's bring back program. My name is XXXX and assisting me is YYYY. I work here at Greater Lawrence and YYYY is from Northeastern University, one of the researchers that are studying the program. We are hoping to learn about patient experiences with pain medication and what we can do to help people prevent the medication from falling into the hands of family members and friends. This information will help us make changes to the program to increase the number of people returning their unused pain medication to the pharmacy. We are having discussions like this with two groups of patients from Greater Lawrence. You were invited because at some point you were prescribed an opioid pain medication and were notified about the bring back program by the pharmacist.

**2. Guidelines**

There are no right or wrong answers in our discussion, but rather differing points of view. Please feel free to share your point of view even if it differs from what others have said. Keep in mind that we're just as interested in negative comments as positive comments, and at times the negative comments are the most helpful.

You've probably noticed my iPhone. We're tape recording the session because we don't want to miss any of your comments. People often say very helpful things in these discussions and we can't write fast enough to get them all down.

Because we are recording, we ask that you silence your phones. If you cannot and if you must respond to a call, please feel free to step away quietly and rejoin us as quickly as you can.

We will be on a first name basis today, but we won't use any names in our reports. You may be assured of complete confidentiality. A summary of the reports will be used by our staff and the researchers to help them make changes to the program, but your name and identity will never be revealed or published either directly or indirectly. Before we begin, do you have any questions?

**3. Topics/Questions to Cover**

*For Everyone*

- How long does it take you to get to the community health center (e.g., are they far away?)
- How do you usually get to the community health center (e.g. walk, bus, drive)?
- How long have you been a patient of Greater Lawrence?
- Do you have other friends and family member who are patients?

- How many times have you been prescribed pain medication (e.g., are they "naive")?
- Why were you prescribed pain medication recently?
- Did you know that they were prescribed an opioid?
- Did the doctor explain to you this kind of medication may be addictive?
- Did the doctor suggest any alternatives to treat your pain?
- How many pills did you receive? How many pills did you take? How much medication was left over?

- Did you notice the return kiosks in the pharmacy?
- Do you remember being notified about the bring back program by the pharmacist?
- Do you remember receiving an information card about the program?
- Did the pharmacist answer all of your questions?
- Did you receive a text message as a reminder?

*For Those Who Returned Medication*

- How long did you wait before returning your medication?
- Why did you choose to bring back your medication to the pharmacy?
- Did you receive a text message? If so, was it a factor in bringing back the medication?
- Did you receive a gift card? If so, was it a factor in bringing back the medication?

- How many pills did you bring back?
- Do you remember what day of the week and time of day that you brought back your medication?

- How long did you have to wait to talk to a pharmacist to return the medication?

- Did the pharmacist understand that you were bringing back pain medication as part of the program?
- How long did the bring back process take?
- Overall, how was your experience with returning your medication to the pharmacy?

*For Those Who Did Not Return Medication*

- Why did you choose not to bring back your medication to the pharmacy?

- Did you receive a text message? If so, did you think about bringing back your medication?
  If not, would that have encouraged you to bring it back?

- Were you offered a gift card? If so, did you consider bringing back your medication to get it? Would you have brought back the medication for a $20 gift card? What amount would make it worth it?

- Do you have any unused pain medication? If so, where is it now? Did you think about bringing it back today? Would you consider bringing it back after this discussion?

- Are you concerned that someone living in your household might take it by accident? Or purposefully take it without your consent it?

- Would you have brought back your medication if the doctor had asked you to do so?

- What other things would you suggest we do to encourage people to bring back their medication?

## Figure A1. Notification Script and Card

Panel A. Information-Only Intervention

1. English



Health Center Logo Here

Name:_____

Rx:_____

**Opioid Medication Bring Back Program**

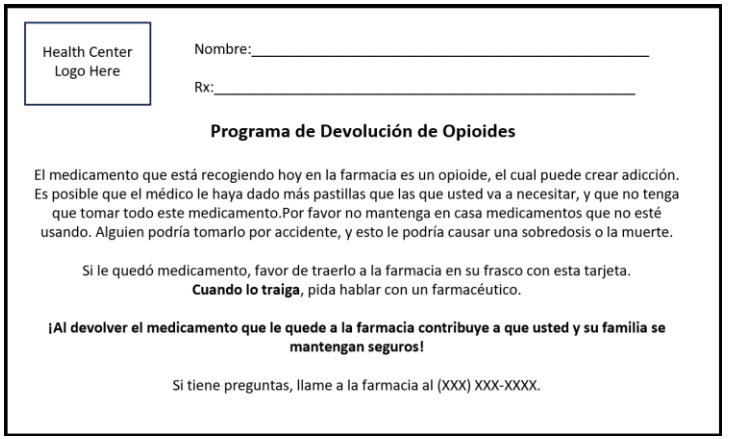
The opioid medication you are picking up today can be addictive. The clinician may have given you more pills than you will need. You may not need to take all of the medication. You do not want to keep unused medication in your house. Someone might take it by accident. This could cause overdose or death.

If you have medication left over, please bring it back here to the pharmacy in the bottle with this card. When you **bring your medication back**, ask to talk to a pharmacist.

**Bringing your medication back to the pharmacy can help keep you and your family safe!**

Questions? Please call the pharmacy at (XXX) XXX-XXXX.

2. Spanish



Health Center Logo Here

Nombre:_____

Rx:_____

**Programa de Devolución de Opioides**

El medicamento que está recogiendo hoy en la farmacia es un opioide, el cual puede crear adicción. Es posible que el médico le haya dado más pastillas que las que usted va a necesitar, y que no tenga que tomar todo este medicamento.Por favor no mantenga en casa medicamentos que no esté usando. Alguien podría tomarlo por accidente, y esto le podría causar una sobredosis o la muerte.

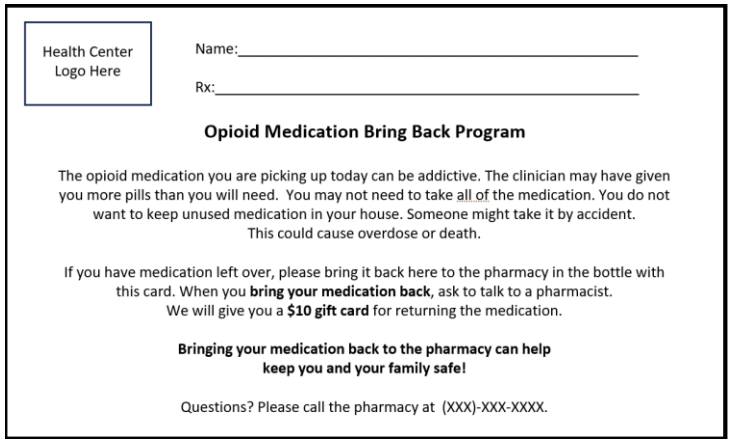
Si le quedó medicamento, favor de traerlo a la farmacia en su frasco con esta tarjeta. **Cuando lo traiga**, pida hablar con un farmacéutico.

**¡Al devolver el medicamento que le quede a la farmacia contribuye a que usted y su familia se mantengan seguros!**

Si tiene preguntas, llame a la farmacia al (XXX) XXX-XXXX.

Panel B. Information Combined with Financial Incentive

1. English



Health Center Logo Here

Name:_____

Rx:_____

**Opioid Medication Bring Back Program**

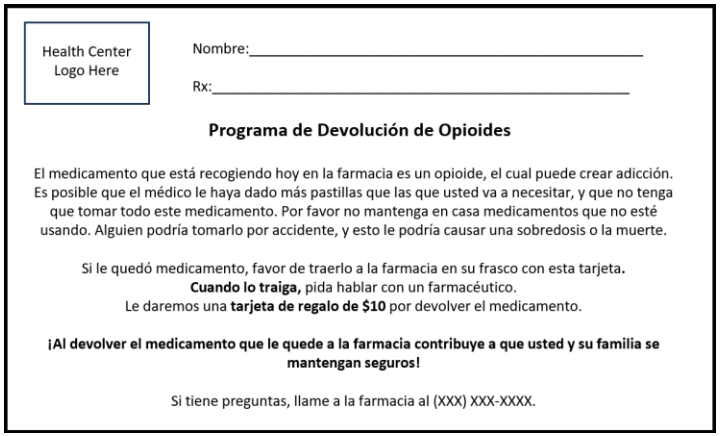
The opioid medication you are picking up today can be addictive. The clinician may have given you more pills than you will need. You may not need to take all of the medication. You do not want to keep unused medication in your house. Someone might take it by accident. This could cause overdose or death.

If you have medication left over, please bring it back here to the pharmacy in the bottle with this card. When you **bring your medication back**, ask to talk to a pharmacist.
We will give you a **$10 gift card** for returning the medication.

**Bringing your medication back to the pharmacy can help keep you and your family safe!**

Questions? Please call the pharmacy at (XXX)-XXX-XXXX.

2. Spanish



Health Center Logo Here

Nombre:_____

Rx:_____

**Programa de Devolución de Opioides**

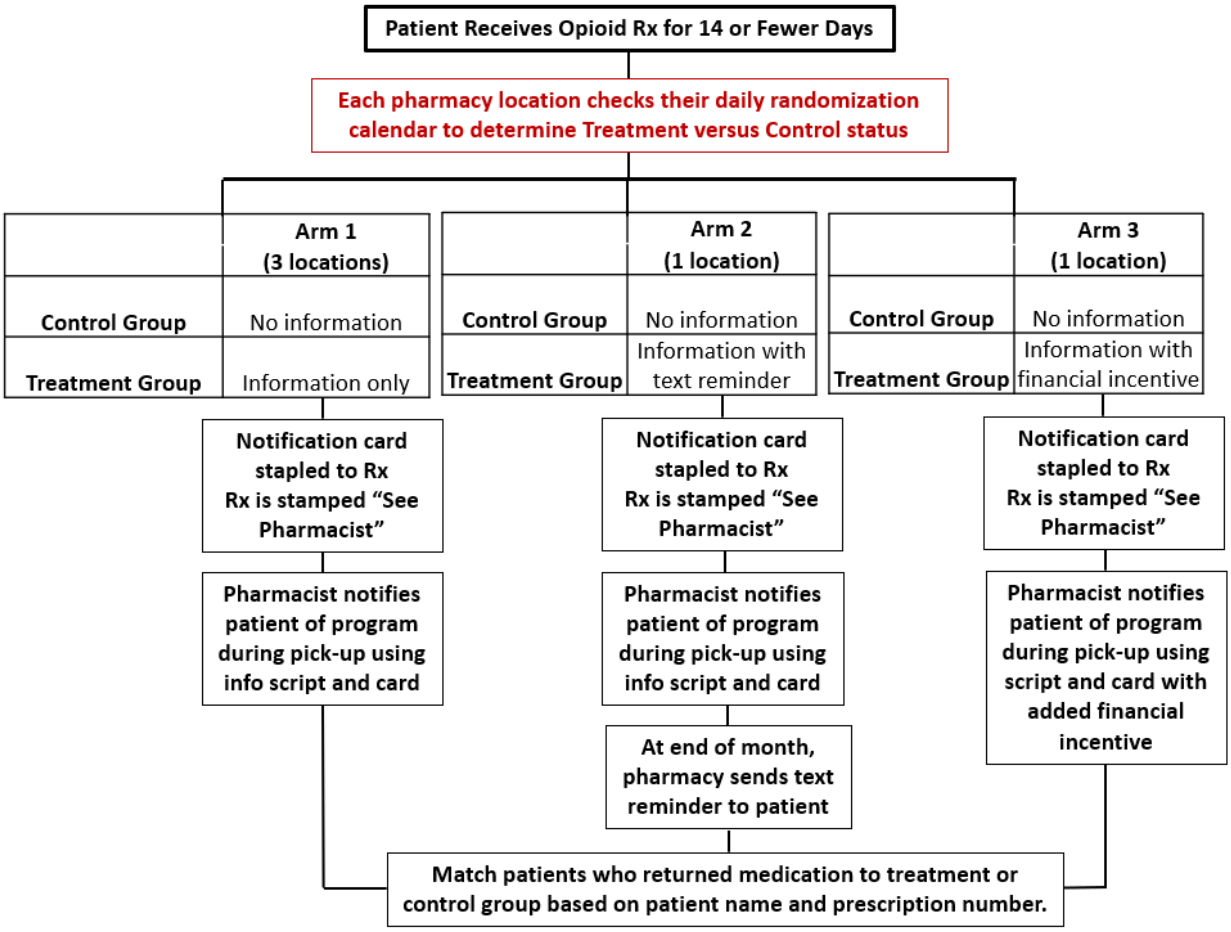
El medicamento que está recogiendo hoy en la farmacia es un opioide, el cual puede crear adicción. Es posible que el médico le haya dado más pastillas que las que usted va a necesitar, y que no tenga que tomar todo este medicamento. Por favor no mantenga en casa medicamentos que no esté usando. Alguien podría tomarlo por accidente, y esto le podría causar una sobredosis o la muerte.

Si le quedó medicamento, favor de traerlo a la farmacia en su frasco con esta tarjeta.
**Cuando lo traiga,** pida hablar con un farmacéutico.
Le daremos una **tarjeta de regalo de $10** por devolver el medicamento.

**¡Al devolver el medicamento que le quede a la farmacia contribuye a que usted y su familia se mantengan seguros!**

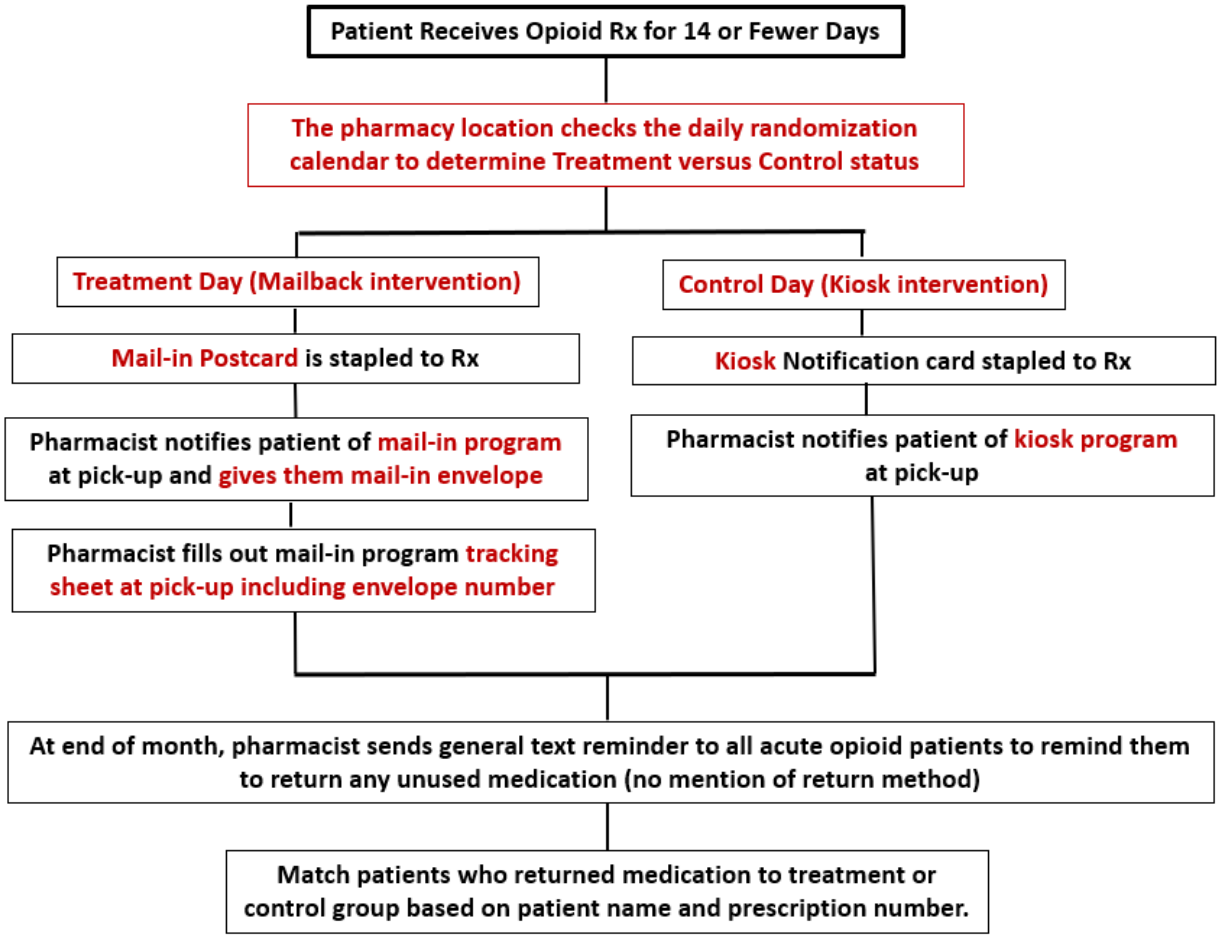
Si tiene preguntas, llame a la farmacia al (XXX) XXX-XXXX.

## Figure A2: Initial Kiosk Intervention Treatment Arms



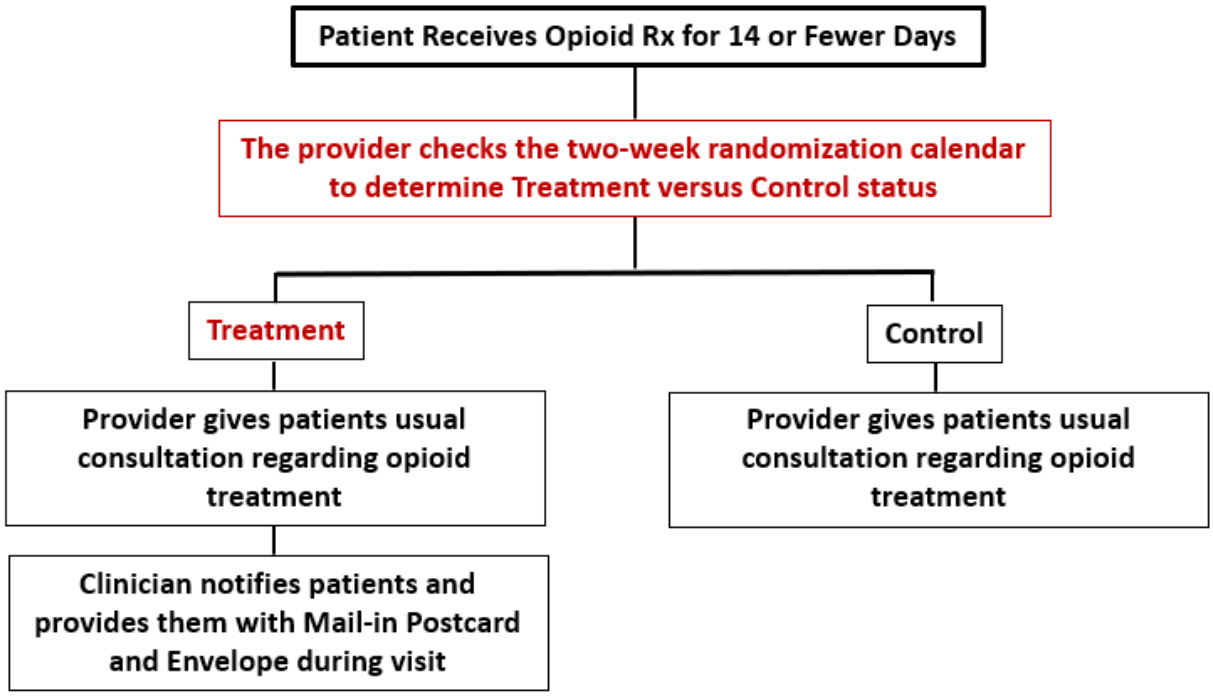

*Source:* Authors' rendering from research protocol in AEARCTR-0004041 (Modestino, 2019).

## Figure A3: Modified Mail-back versus Kiosk Intervention



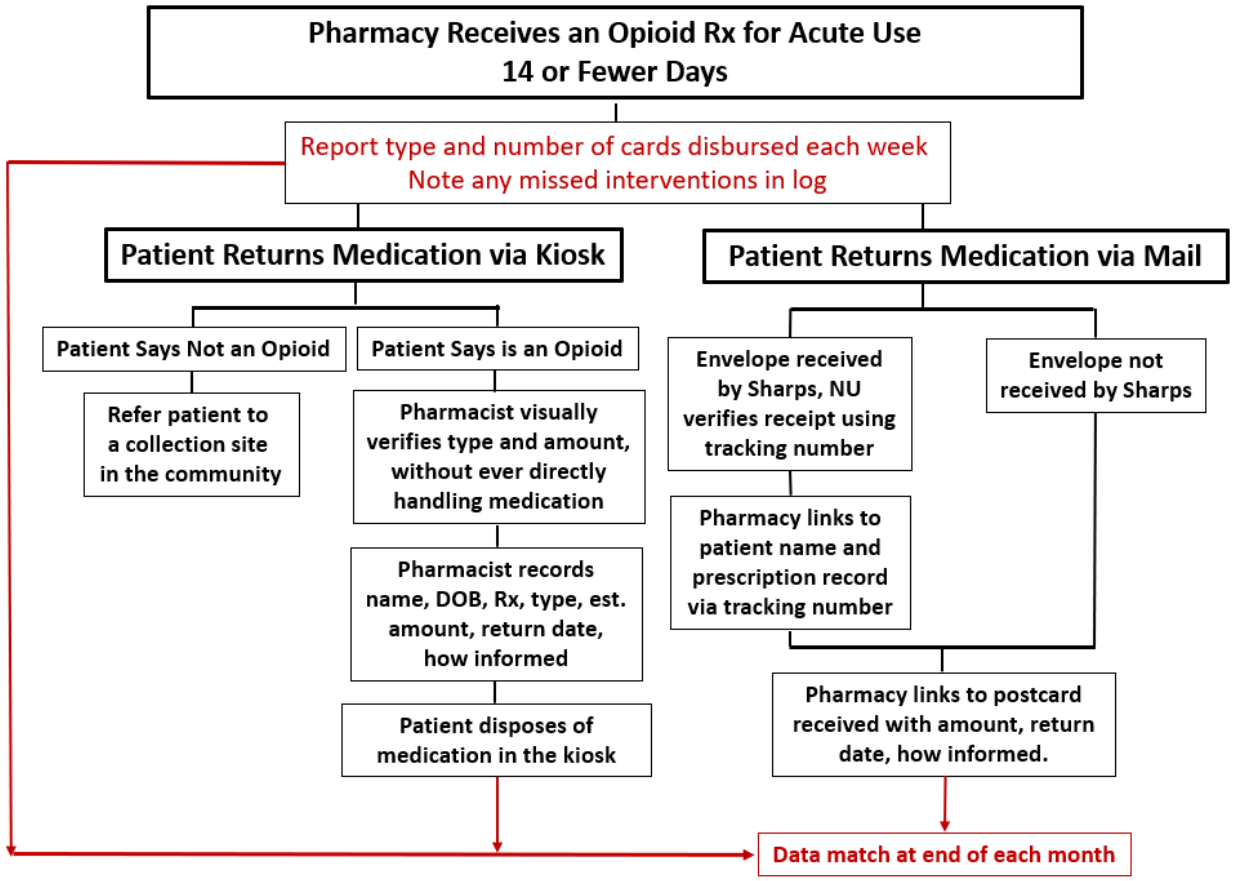

*Source:* Authors' rendering from revised research protocol submitted to J-PAL.

## Figure A4: Modified Clinician Intervention



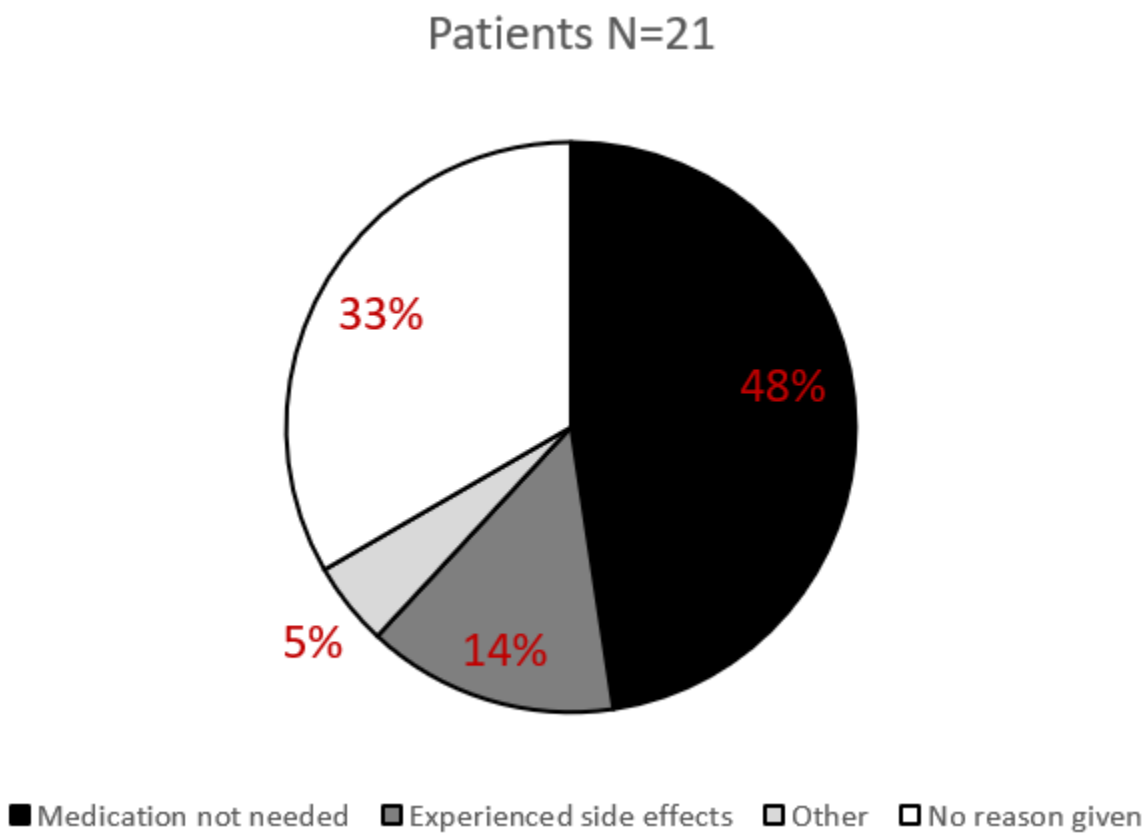

*Source:* Authors' rendering from revised research protocol submitted to J-PAL.

## Figure A5. Opioid Return and Data Collection Protocol




*Source:* Authors' rendering from research protocol in AEARCTR-0004041 (Modestino, 2019) and revised research protocol submitted to J-PAL.

**Figure A6: Reason Given for Returning Opioid Medication, Kiosk Intervention**




*Source:* Authors' calculations based on data provided by the community health center.

## Table A1. Characteristics of Pharmacy Staff Surveyed after Kiosk Intervention

| | Number | Percentage |
|---|---|---|
| Pharmacy location | | |
| Information only treatment arm | 7 | 31.8% |
| Information plus financial incentive treatment arm | 11 | 50.0% |
| Information plus text message treatment arm | 4 | 18.2% |
| | | |
| Years of experience | | |
| 3-5 years | 2 | 9.1% |
| 6-10 years | 3 | 13.6% |
| More than 10 years | 17 | 77.3% |
| | | |
| Job title | | |
| Manager | 4 | 18.2% |
| Registered Pharmacist (RPH) | 18 | 81.8% |
| | | |
| Number of patients consulted with regarding the opioid return program | | |
| 1-10 patients | 6 | 27.3% |
| 11-24 patients | 7 | 31.8% |
| 25-50 patients | 3 | 13.6% |
| 50-100 patients | 2 | 9.1% |
| More than 100 patients | 2 | 9.1% |
| None | 2 | 9.1% |
| | | |
| N | 22 | 100.0% |

*Source:* Authors' calculations using data provided by the community health center.

## Table A2. Characteristics of Patients Interviewed in the Treatment Group after Kiosk Intervention

| | Treatment Group | | |
|---|---|---|---|
| | All Patients | Interviewed Patients | Difference: Interviewed-All |
| Mean age | 50.17 | 46.67 | -3.50 |
| Gender | | | |
| Percent female | 59% | 70% | 11.00 |
| Race | | | |
| Percent black | 14% | 20% | 6.00 |
| Percent other | 7% | 20% | 13.00 |
| Percent white | 53% | 60% | 7.00 |
| Language spoken | | | |
| Percent English | 22% | 40% | 18.00 |
| Percent Spanish | 67% | 60% | -7.00 |
| Number of people in household | 2.47 | 2.50 | 3.00 |
| Returned medication | 3% | 20% | 17.00 |
| N | 687 | 10 | -677 |

*Source:* Authors' calculations using data provided by the community health center.

## B. Robustness Checks

### Table B1. Balance Test for Information-Only Arm of Kiosk Intervention

| | Treatment Group | | Control Group | | Treatment - Control | | |
|---|---|---|---|---|---|---|---|
| | Mean | SE | Mean | SE | Diff. | P-value | Chi-Square |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Mean Age (years) | 51.20 | (1.07) | 50.16 | (1.18) | 1.05 | 0.51 | |
| Percent Female | 0.56 | (0.03) | 0.60 | (0.03) | -0.04 | 0.39 | |
| Percent White | 0.50 | (0.03) | 0.46 | (0.03) | 0.05 | 0.31 | 0.18 |
| Percent Black or African American | 0.15 | (0.02) | 0.23 | (0.03) | -0.09 | 0.01** | |
| Percent Dominican | 0.16 | (0.02) | 0.15 | (0.02) | 0.01 | 0.69 | |
| Percent Other Race | 0.09 | (0.02) | 0.08 | (0.02) | 0.02 | 0.47 | |
| Percent Race Unknown | 0.10 | (0.02) | 0.09 | (0.02) | 0.01 | 0.72 | |
| Percent English Speaking | 0.26 | (0.03) | 0.21 | (0.03) | 0.05 | 0.21 | 0.58 |
| Percent Spanish Speaking | 0.65 | (0.03) | 0.70 | (0.03) | -0.05 | 0.20 | |
| Percent Other Language | 0.01 | (0.01) | 0.00 | (0.00) | 0.00 | 0.61 | |
| Percent Language Unknown | 0.08 | (0.02) | 0.08 | (0.02) | 0.00 | 0.93 | |
| Percent Single | 0.53 | (0.03) | 0.51 | (0.03) | 0.02 | 0.61 | 0.69 |
| Percent Married | 0.32 | (0.03) | 0.32 | (0.03) | -0.00 | 0.94 | |
| Percent Divorced/Widowed/Separated | 0.11 | (0.02) | 0.11 | (0.02) | 0.00 | 0.88 | |
| Percent Marital Status Unknown | 0.04 | (0.01) | 0.07 | (0.02) | -0.02 | 0.24 | |
| Mean Family Size | 2.41 | (0.11) | 2.74 | (0.11) | -0.34 | 0.03** | |
| Percent Family Size Unknown | 0.11 | (0.02) | 0.10 | (0.02) | 0.01 | 0.75 | |
| Quantity Supplied (number of pills) | 18.67 | (0.90) | 16.59 | (0.68) | 2.08 | 0.07 | |
| Days Supply (number of days) | 4.98 | (0.17) | 4.85 | (0.19) | 0.14 | 0.59 | |
| Percent Opioid Schedule II (strong) | 0.53 | (0.03) | 0.52 | (0.03) | 0.01 | 0.82 | 0.83 |
| Percent Opioid Schedule III (moderate) | 0.25 | (0.03) | 0.27 | (0.03) | -0.02 | 0.56 | |
| Percent Opioid Schedule IV and V (weak) | 0.22 | (0.03) | 0.21 | (0.03) | 0.01 | 0.73 | |
| Percent Returning Medication | 0.01 | (0.01) | 0.00 | (0.00) | 0.01 | 0.09* | |
| Number of Observations | 233 | | 259 | | 492 | | |

*Source:* Authors' calculations using data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B2. Balance Test for Text Message Reminder Arm of Kiosk Intervention

| | Treatment Group | | Control Group | | Treatment - Control | | |
|---|---|---|---|---|---|---|---|
| | Mean | SE | Mean | SE | Diff. | P-value | Chi-Square |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Mean Age (years) | 48.33 | (1.46) | 51.00 | (1.36) | -2.67 | 0.18 | |
| Percent Female | 0.64 | (0.04) | 0.71 | (0.04) | -0.07 | 0.18 | |
| Percent White | 0.61 | (0.04) | 0.51 | (0.04) | 0.10 | 0.08* | 0.24 |
| Percent Black or African American | 0.10 | (0.03) | 0.12 | (0.03) | -0.01 | 0.72 | |
| Percent Dominican | 0.15 | (0.03) | 0.23 | (0.03) | -0.08 | 0.10 | |
| Percent Other Race | 0.04 | (0.02) | 0.07 | (0.02) | -0.03 | 0.23 | |
| Percent Race Unknown | 0.09 | (0.02) | 0.07 | (0.02) | 0.02 | 0.47 | |
| Percent English Speaking | 0.14 | (0.03) | 0.11 | (0.02) | 0.03 | 0.36 | 0.62 |
| Percent Spanish Speaking | 0.79 | (0.03) | 0.83 | (0.03) | -0.04 | 0.35 | |
| Percent Other Language | 0.00 | (0.00) | 0.00 | (0.00) | 0.00 | . | |
| Percent Language Unknown | 0.07 | (0.02) | 0.06 | (0.02) | 0.01 | 0.78 | |
| Percent Single | 0.55 | (0.04) | 0.47 | (0.04) | 0.08 | 0.17 | 0.45 |
| Percent Married | 0.29 | (0.04) | 0.36 | (0.04) | -0.07 | 0.22 | |
| Percent Divorced/Widowed/Separated | 0.14 | (0.03) | 0.14 | (0.03) | 0.00 | 0.94 | |
| Percent Marital Status Unknown | 0.02 | (0.01) | 0.04 | (0.01) | -0.02 | 0.40 | |
| Mean Family Size | 2.52 | (0.13) | 2.49 | (0.14) | 0.03 | 0.87 | |
| Percent Family Size Unknown | 0.12 | (0.03) | 0.09 | (0.02) | 0.03 | 0.47 | |
| Quantity Supplied (number of pills) | 19.29 | (2.24) | 18.19 | (1.08) | 1.11 | 0.65 | |
| Days Supply (number of days) | 5.03 | (0.22) | 4.80 | (0.25) | 0.23 | 0.48 | |
| Percent Opioid Schedule II (strong) | 0.64 | (0.04) | 0.64 | (0.04) | -0.00 | 0.95 | 0.70 |
| Percent Opioid Schedule III (moderate) | 0.15 | (0.03) | 0.12 | (0.03) | 0.03 | 0.46 | |
| Percent Opioid Schedule IV and V (weak) | 0.21 | (0.03) | 0.24 | (0.03) | -0.03 | 0.59 | |
| Percent Returning Medication | 0.03 | (0.02) | 0.00 | (0.00) | 0.03 | 0.02** | |
| Number of Observations | 143 | | 161 | | 304 | | |

*Source:* Authors' calculations using data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B3. Balance Test for Financial Arm of Kiosk Intervention

| | Treatment Group | | Control Group | | Treatment - Control | | |
|---|---|---|---|---|---|---|---|
| | Mean | SE | Mean | SE | Diff. | P-value | Chi-Square |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Mean Age (years) | 50.16 | (0.96) | 50.60 | (0.85) | -0.44 | 0.73 | |
| Percent Female | 0.59 | (0.03) | 0.59 | (0.03) | 0.00 | 0.97 | |
| Percent White | 0.53 | (0.03) | 0.56 | (0.03) | -0.03 | 0.44 | 0.55 |
| Percent Black or African American | 0.16 | (0.02) | 0.18 | (0.02) | -0.02 | 0.60 | |
| Percent Dominican | 0.12 | (0.02) | 0.10 | (0.02) | 0.02 | 0.35 | |
| Percent Other Race | 0.06 | (0.01) | 0.07 | (0.01) | -0.01 | 0.63 | |
| Percent Race Unknown | 0.13 | (0.02) | 0.10 | (0.02) | 0.03 | 0.19 | |
| Percent English Speaking | 0.22 | (0.02) | 0.22 | (0.02) | 0.01 | 0.77 | 0.74 |
| Percent Spanish Speaking | 0.62 | (0.03) | 0.65 | (0.02) | -0.03 | 0.40 | |
| Percent Other Language | 0.01 | (0.00) | 0.00 | (0.00) | 0.00 | 0.42 | |
| Percent Language Unknown | 0.15 | (0.02) | 0.14 | (0.02) | 0.02 | 0.54 | |
| Percent Single | 0.50 | (0.03) | 0.51 | (0.03) | -0.00 | 0.93 | 0.76 |
| Percent Married | 0.29 | (0.03) | 0.31 | (0.02) | -0.02 | 0.50 | |
| Percent Divorced/Widowed/Separated | 0.14 | (0.02) | 0.13 | (0.02) | 0.01 | 0.67 | |
| Percent Marital Status Unknown | 0.07 | (0.01) | 0.05 | (0.01) | 0.02 | 0.39 | |
| Mean Family Size | 2.51 | (0.10) | 2.45 | (0.08) | 0.06 | 0.63 | |
| Percent Family Size Unknown | 0.12 | (0.02) | 0.11 | (0.02) | 0.01 | 0.81 | |
| Quantity Supplied (number of pills) | 19.03 | (0.94) | 19.12 | (0.85) | -0.09 | 0.94 | |
| Days Supply (number of days) | 4.52 | (0.15) | 4.39 | (0.14) | 0.13 | 0.53 | |
| Percent Opioid Schedule II (strong) | 0.67 | (0.03) | 0.74 | (0.02) | -0.07 | 0.07* | 0.09* |
| Percent Opioid Schedule III (moderate) | 0.13 | (0.02) | 0.10 | (0.02) | 0.04 | 0.15 | |
| Percent Opioid Schedule IV and V (weak) | 0.20 | (0.02) | 0.17 | (0.02) | 0.03 | 0.32 | |
| Percent Returning Medication | 0.04 | (0.01) | 0.00 | (0.00) | 0.04 | 0.00*** | |
| Number of Observations | 289 | | 376 | | 665 | | |

*Source:* Authors' calculations using data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B4. Balance Test for Mail-back Intervention

| | Treatment Group | | Control Group | | Treatment - Control | | |
|---|---|---|---|---|---|---|---|
| | Mean (1) | SE (2) | Mean (3) | SE (4) | Diff. (5) | P-value (6) | Chi-Square (7) |
| Mean Age (years) | 49.09 | (2.25) | 50.09 | (1.85) | -1.00 | 0.73 | |
| Percent Female | 0.55 | (0.07) | 0.66 | (0.05) | -0.11 | 0.19 | |
| Percent White | 0.48 | (0.07) | 0.47 | (0.05) | 0.01 | 0.90 | 0.54 |
| Percent Black or African American | 0.19 | (0.05) | 0.15 | (0.04) | 0.04 | 0.57 | |
| Percent Dominican | 0.09 | (0.04) | 0.10 | (0.03) | -0.01 | 0.80 | |
| Percent Other Race | 0.07 | (0.03) | 0.15 | (0.04) | -0.08 | 0.12 | |
| Percent Race Unknown | 0.17 | (0.05) | 0.12 | (0.03) | 0.05 | 0.38 | |
| Percent English Speaking | 0.22 | (0.06) | 0.21 | (0.04) | 0.02 | 0.83 | |
| Percent Spanish Speaking | 0.62 | (0.06) | 0.64 | (0.05) | -0.02 | 0.84 | 0.37 |
| Percent Other Language | 0.00 | (0.00) | 0.04 | (0.02) | -0.04 | 0.11 | |
| Percent Language Unknown | 0.16 | (0.05) | 0.11 | (0.03) | 0.05 | 0.42 | |
| Percent Single | 0.52 | (0.07) | 0.55 | (0.05) | -0.03 | 0.70 | 0.56 |
| Percent Married | 0.28 | (0.06) | 0.30 | (0.05) | -0.02 | 0.79 | |
| Percent Divorced/Widowed/Separated | 0.09 | (0.04) | 0.10 | (0.03) | -0.01 | 0.80 | |
| Percent Marital Status Unknown | 0.12 | (0.04) | 0.05 | (0.02) | 0.07 | 0.15 | |
| Mean Family Size | 2.79 | (0.20) | 2.45 | (0.14) | 0.33 | 0.17 | |
| Percent Family Size Unknown | 0.19 | (0.05) | 0.08 | (0.03) | 0.11 | 0.04** | |
| Quantity Supplied (number of pills) | 15.22 | (1.10) | 20.65 | (2.24) | -5.42 | 0.07* | |
| Days Supply (number of days) | 4.05 | (0.32) | 4.74 | (0.33) | -0.68 | 0.16 | |
| Percent Opioid Schedule II (strong) | 0.67 | (0.06) | 0.73 | (0.05) | -0.05 | 0.49 | 0.78 |
| Percent Opioid Schedule III (moderate) | 0.09 | (0.04) | 0.08 | (0.03) | 0.01 | 0.84 | |
| Percent Opioid Schedule IV and V (weak) | 0.24 | (0.06) | 0.20 | (0.04) | 0.04 | 0.53 | |
| Percent Returning Medication | 0.07 | (0.03) | 0.03 | (0.02) | 0.04 | 0.31 | |
| Number of Observations | 58 | | 91 | | 149 | | |

*Source:* Authors' calculations using data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B5. Balance Test for Clinician Intervention

| | Treatment Group | | Control Group | | Treatment - Control | | |
|---|---|---|---|---|---|---|---|
| | Mean (1) | SE (2) | Mean (3) | SE (4) | Diff. (5) | P-value (6) | Chi-Square (7) |
| Mean Age (years) | 30.16 | (1.20) | 32.93 | (1.11) | -2.77 | 0.12 | |
| Percent Female | 0.98 | (0.02) | 1.00 | (0.00) | -0.02 | 0.43 | |
| Percent White | 0.36 | (0.07) | 0.39 | (0.09) | -0.04 | 0.75 | 0.76 |
| Percent Black or African American | 0.18 | (0.06) | 0.18 | (0.07) | -0.00 | 0.99 | |
| Percent Dominican | 0.24 | (0.06) | 0.32 | (0.09) | -0.08 | 0.48 | |
| Percent Other Race | 0.18 | (0.06) | 0.07 | (0.05) | 0.11 | 0.20 | |
| Percent Race Unknown | 0.04 | (0.03) | 0.04 | (0.04) | 0.01 | 0.86 | |
| Percent English Speaking | 0.22 | (0.06) | 0.18 | (0.07) | 0.04 | 0.66 | 0.81 |
| Percent Spanish Speaking | 0.73 | (0.07) | 0.79 | (0.08) | -0.05 | 0.62 | |
| Percent Other Language | 0.02 | (0.02) | 0.00 | (0.00) | 0.02 | 0.43 | |
| Percent Language Unknown | 0.02 | (0.02) | 0.04 | (0.04) | -0.01 | 0.74 | |
| Percent Single | 0.64 | (0.07) | 0.57 | (0.10) | 0.07 | 0.54 | 0.75 |
| Percent Married | 0.31 | (0.07) | 0.39 | (0.09) | -0.08 | 0.48 | |
| Percent Divorced/Widowed/Separated | 0.02 | (0.02) | 0.00 | (0.00) | 0.02 | 0.43 | |
| Percent Marital Status Unknown | 0.02 | (0.02) | 0.04 | (0.04) | -0.01 | 0.74 | |
| Mean Family Size | 2.89 | (0.23) | 2.88 | (0.23) | 0.00 | 1.00 | |
| Percent Family Size Unknown | 0.02 | (0.02) | 0.07 | (0.05) | -0.05 | 0.31 | |
| Quantity Supplied (number of pills) | 9.69 | (1.14) | 9.60 | (1.91) | 0.09 | 0.97 | |
| Percent Returning Medication | 0.04 | (0.03) | 0.00 | (0.00) | 0.04 | 0.26 | |
| Number of Observations | 45 | | 28 | | 73 | | |

*Source:* Authors' calculations using data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B6. Impact of Kiosk Intervention across All Three Treatment Arms Combined using Non-Linear Specification (Logit)

| | (1) Difference in Means | (2) Controlling for Demographics |
|---|---|---|
| Treated * Information Only | ----- | ----- |
| Treated *Text Reminder | 2.51*** | 2.98*** |
| | (0.015) | (0.011) |
| Treated *Financial Incentive | 2.69*** | 2.86*** |
| | (0.012) | (0.008) |
| Controlling for: | | |
| Location of pharmacy | No | No |
| Age | No | Yes |
| Gender | No | Yes |
| Race | No | Yes |
| Language | No | Yes |
| Marital status | No | Yes |
| Number of observations | 1461 | 1461 |
| Pseudo R squared | 0.13 | 0.33 |

*Source:* Authors' calculations based on data provided by the community health center.
*Notes:* The variable *Treated* is omitted from the logit specification due to perfect prediction. Specifically, all treated observations (where *Treated = 1*) result in a return, while none of the untreated observations (where *Treated = 0*) do. In such cases, maximum likelihood estimation fails to converge because the model perfectly classifies outcomes based on the predictor. Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 level

## Table B7: Impact of Kiosk Intervention on Medication Return Rates: Information-Only Treatment Arm

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Information Only | 0.012* | 0.011* | 0.011* | 0.011* | 0.011* | 0.011* | 0.011* |
| | (0.007) | (0.007) | (0.006) | (0.006) | (0.007) | (0.007) | (0.007) |
| Mean Age (years) | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Percent Female | | -0.006 | -0.006 | -0.007 | -0.006 | -0.006 | -0.006 |
| | | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| Percent Black or African American | | | -0.002 | -0.004 | -0.003 | -0.004 | -0.004 |
| | | | (0.004) | (0.005) | (0.005) | (0.005) | (0.005) |
| Percent Dominican | | | 0.009 | 0.006 | 0.007 | 0.007 | 0.008 |
| | | | (0.014) | (0.015) | (0.016) | (0.016) | (0.016) |
| Percent Other Race | | | 0.019 | 0.021 | 0.020 | 0.021 | 0.022 |
| | | | (0.024) | (0.026) | (0.026) | (0.026) | (0.026) |
| Percent Race Unknown | | | -0.004 | -0.003 | -0.002 | -0.001 | -0.002 |
| | | | (0.004) | (0.004) | (0.007) | (0.009) | (0.009) |
| Percent Spanish Speaking | | | | 0.009 | 0.008 | 0.008 | 0.007 |
| | | | | (0.007) | (0.007) | (0.007) | (0.006) |
| Percent Other Language | | | | -0.022 | -0.023 | -0.026 | -0.030 |
| | | | | (0.025) | (0.028) | (0.032) | (0.031) |
| Percent Language Unknown | | | | 0.005 | 0.004 | 0.004 | 0.004 |
| | | | | (0.005) | (0.006) | (0.006) | (0.006) |
| Percent Married | | | | | 0.006 | 0.006 | 0.008 |
| | | | | | (0.009) | (0.009) | (0.009) |
| Percent Divorced/Widowed/Separated | | | | | -0.007 | -0.008 | -0.006 |
| | | | | | (0.007) | (0.007) | (0.006) |
| Percent Marital Status Unknown | | | | | 0.005 | 0.003 | -0.000 |
| | | | | | (0.004) | (0.004) | (0.004) |
| Mean Family Size | | | | | -0.000 | -0.000 | -0.000 |
| | | | | | (0.000) | (0.000) | (0.000) |
| Quantity Supplied (number of pills) | | | | | | 0.000 | 0.000 |
| | | | | | | (0.000) | (0.000) |
| Days Supply (number of days) | | | | | | -0.001 | -0.001 |
| | | | | | | (0.002) | (0.002) |
| Percent Opioid Schedule II (strong) | | | | | | | 0.004 |
| | | | | | | | (0.004) |
| Percent Opioid Schedule III (moderate) | | | | | | | 0.020 |
| | | | | | | | (0.014) |
| Observations | 492 | 492 | 492 | 492 | 492 | 492 | 492 |
| $R^2$ | 0.006 | 0.009 | 0.016 | 0.019 | 0.021 | 0.023 | 0.032 |

*Source:* Authors' calculations based on data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B8: Impact of Kiosk Intervention on Medication Return Rates: Text Message Treatment Arm

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Text Message + Information | 0.0350** | 0.0367** | 0.0404** | 0.0406** | 0.0414** | 0.0417** | 0.0406** |
| | (0.015) | (0.016) | (0.018) | (0.018) | (0.018) | (0.018) | (0.018) |
| Mean Age (years) | | -0.0001 | 0.0001 | 0.0000 | -0.0002 | -0.0001 | -0.0001 |
| | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Percent Female | | 0.0271** | 0.0271** | 0.0273** | 0.0271** | 0.0275** | 0.0294** |
| | | (0.012) | (0.012) | (0.012) | (0.012) | (0.013) | (0.014) |
| Percent Black or African American | | | 0.0578 | 0.0555 | 0.0524 | 0.0521 | 0.0536 |
| | | | (0.042) | (0.042) | (0.043) | (0.043) | (0.043) |
| Percent Dominican | | | 0.0336 | 0.0309 | 0.0285 | 0.0284 | 0.0262 |
| | | | (0.025) | (0.025) | (0.024) | (0.024) | (0.023) |
| Percent Other Race | | | 0.0030 | 0.0017 | -0.0017 | -0.0014 | -0.0048 |
| | | | (0.008) | (0.009) | (0.009) | (0.008) | (0.008) |
| Percent Race Unknown | | | 0.0056 | 0.0012 | 0.0096 | 0.0120 | 0.0147 |
| | | | (0.007) | (0.015) | (0.017) | (0.013) | (0.015) |
| Percent Spanish Speaking | | | | 0.0173 | 0.0175 | 0.0161 | 0.0199* |
| | | | | (0.011) | (0.013) | (0.010) | (0.011) |
| Percent Other Language | | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | | | (.) | (.) | (.) | (.) |
| Percent Language Unknown | | | | 0.0191 | 0.0293 | 0.0290 | 0.0321 |
| | | | | (0.019) | (0.026) | (0.024) | (0.026) |
| Percent Married | | | | | 0.0250 | 0.0252 | 0.0255 |
| | | | | | (0.020) | (0.020) | (0.020) |
| Percent Divorced/Widowed/Separated | | | | | 0.0201 | 0.0224 | 0.0208 |
| | | | | | (0.029) | (0.034) | (0.035) |
| Percent Marital Status Unknown | | | | | 0.0021 | 0.0018 | 0.0031 |
| | | | | | (0.008) | (0.008) | (0.009) |
| Family Size | | | | | -0.0001 | -0.0001 | -0.0002 |
| | | | | | (0.000) | (0.000) | (0.000) |
| Quantity Supplied (number of pills) | | | | | | 0.0000 | 0.0000 |
| | | | | | | (0.000) | (0.000) |
| Days Supply (number of days) | | | | | | -0.0011 | 0.0002 |
| | | | | | | (0.003) | (0.004) |
| Percent Opioid Schedule II (strong) | | | | | | | 0.0198 |
| | | | | | | | (0.014) |
| Percent Opioid Schedule III (moderate) | | | | | | | 0.0317 |
| | | | | | | | (0.025) |
| Observations | 304 | 304 | 304 | 304 | 304 | 304 | 304 |
| $R^2$ | 0.019 | 0.029 | 0.054 | 0.055 | 0.063 | 0.064 | 0.069 |

*Source:* Authors' calculations based on data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B9. Impact of Kiosk Intervention on Medication Return Rates: Financial Incentive Treatment Arm

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Financial Incentive + Information | 0.042*** | 0.041*** | 0.041*** | 0.040*** | 0.039*** | 0.040*** | 0.038*** |
| | (0.012) | (0.012) | (0.012) | (0.011) | (0.011) | (0.011) | (0.011) |
| Mean Age (years) | | -0.000 | -0.000 | -0.000 | -0.001* | -0.000 | -0.000 |
| | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Percent Female | | -0.003 | -0.001 | -0.003 | -0.005 | -0.006 | -0.008 |
| | | (0.010) | (0.010) | (0.010) | (0.011) | (0.012) | (0.012) |
| Percent Black or African American | | | 0.014 | 0.015 | 0.013 | 0.013 | 0.014 |
| | | | (0.016) | (0.016) | (0.016) | (0.016) | (0.016) |
| Percent Dominican | | | -0.000 | -0.001 | -0.004 | -0.003 | -0.001 |
| | | | (0.015) | (0.016) | (0.016) | (0.016) | (0.016) |
| Percent Other Race | | | 0.012 | 0.014 | 0.011 | 0.015 | 0.011 |
| | | | (0.022) | (0.022) | (0.022) | (0.023) | (0.021) |
| Percent Race Unknown | | | 0.027 | 0.038* | 0.058* | 0.054* | 0.056* |
| | | | (0.023) | (0.022) | (0.032) | (0.030) | (0.030) |
| Percent Spanish Speaking | | | | 0.011 | 0.012 | 0.011 | 0.010 |
| | | | | (0.010) | (0.011) | (0.010) | (0.010) |
| Percent Other Language | | | | 0.323 | 0.342 | 0.331 | 0.322 |
| | | | | (0.267) | (0.260) | (0.261) | (0.268) |
| Percent Language Unknown | | | | -0.002 | 0.017 | 0.020 | 0.018 |
| | | | | (0.006) | (0.013) | (0.014) | (0.015) |
| Percent Married | | | | | 0.014 | 0.012 | 0.012 |
| | | | | | (0.012) | (0.012) | (0.011) |
| Percent Divorced/Widowed/Separated | | | | | 0.020 | 0.020 | 0.021 |
| | | | | | (0.018) | (0.018) | (0.018) |
| Percent Marital Status Unknown | | | | | 0.007 | 0.003 | 0.009 |
| | | | | | (0.043) | (0.043) | (0.043) |
| Family Size | | | | | -0.001* | -0.001* | -0.001** |
| | | | | | (0.000) | (0.000) | (0.000) |
| Quantity Supplied (number of pills) | | | | | | -0.000 | 0.000 |
| | | | | | | (0.000) | (0.000) |
| Days Supply (number of days) | | | | | | -0.004** | -0.004** |
| | | | | | | (0.002) | (0.002) |
| Percent Opioid Schedule II (strong) | | | | | | | -0.006 |
| | | | | | | | (0.009) |
| Percent Opioid Schedule III (moderate) | | | | | | | 0.041 |
| | | | | | | | (0.027) |
| Observations | 665 | 665 | 665 | 665 | 665 | 665 | 665 |
| $R^2$ | 0.024 | 0.026 | 0.031 | 0.057 | 0.074 | 0.081 | 0.093 |

*Source:* Authors' calculations based on data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.

## Table B.10 Table 5: Exploring Heterogeneity in Medication Returns: Financial Treatment Arm of Kiosk Intervention

| | (1) | | (2) | | (3) | | |
|---|---|---|---|---|---|---|---|
| | Returned Medication | | Did Not Return Medication | | Returned - Did Not Return | | |
| | Mean | SE | Mean | SE | Difference | p-value | chi-square |
| Mean Age (years) | 43 | 4.45 | 49.64 | 1.03 | -6.64 | 0.2 | |
| Percent Female | 0.64 | 0.15 | 0.57 | 0.03 | 0.07 | 0.67 | |
| Percent White | 0.36 | 0.15 | 0.56 | 0.3 | -0.2 | 0.19 | 0.59 |
| Percent Black or African American | 0.27 | 0.14 | 0.15 | 0.02 | 0.12 | 0.29 | |
| Percent Dominican | 0.09 | 0.09 | 0.13 | 0.02 | -0.04 | 0.72 | |
| Percent Other Race | 0.09 | 0.09 | 0.04 | 0.01 | 0.05 | 0.43 | |
| Percent Race Unknown | 0.18 | 0.12 | 0.11 | 0.02 | 0.07 | 0.48 | |
| Percent English Speaking | 0.09 | 0.09 | 0.26 | 0.03 | -0.17 | 0.22 | 0.01*** |
| Percent Spanish Speaking | 0.73 | 0.14 | 0.61 | 0.03 | 0.12 | 0.42 | |
| Percent Language Unknown | 0.09 | 0.09 | 0.14 | 0.02 | -0.05 | 0.67 | |
| Percent Single | 0.36 | 0.15 | 0.52 | 0.03 | -0.16 | 0.31 | 0.80 |
| Percent Married | 0.36 | 0.15 | 0.27 | 0.03 | 0.09 | 0.50 | |
| Percent Divorced/Widowed/Separated | 0.18 | 0.12 | 0.14 | 0.02 | 0.04 | 0.72 | |
| Percent Marital Status Unknown | 0.09 | 0.09 | 0.06 | 0.02 | 0.03 | 0.77 | |
| Mean Family Size | 2.10 | 0.48 | 2.52 | 0.1 | -0.42 | 0.38 | |
| Quantity Supplied (number of pills) | 9.55 | 0.8 | 19.11 | 0.97 | -9.56 | 0.05** | |
| Day Supply (number of days) | 2.55 | 0.37 | 4.52 | 0.16 | -1.97 | 0.01** | |
| Percent Opioid Schedule II (strong) | 0.55 | 0.16 | 0.75 | 0.03 | -0.2 | 0.13 | 0.03** |
| Percent Opioid Schedule III (moderate) | 0.36 | 0.15 | 0.1 | 0.19 | 0.26 | 0.01*** | |
| Percent Opioid Schedule IV and V (weak) | 0.09 | 0.09 | 0.15 | 0.02 | -0.06 | 0.59 | |
| Number of Observations | 11 | | 266 | | 277 | | |

*Source:* Authors' calculations based on data provided by the community health center.
*Notes:* Statistical significance is indicated at the *p<0.10, **p<0.05, and ***p<0.001 levels.