

Impact of One-Way SMS Health Communication to Increase PrEP Uptake in Non-HIV, STI Testing Patients: A Pre-Post Intervention Study

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Abstract

There are about 1.1 million people currently living with HIV and 15% are unaware of their HIV status. Pre-Exposure Prophylaxis (PrEP) is a prophylactic treatment with the use of Anti-Retro Viral (ARV) medications to prevent HIV transmission. The current study used secondary de-identified data from clinic visits between August 1, 2022, to Jan 31, 2023, to evaluate the impact of one-way SMS communication to increase PrEP uptake in non-HIV, STI testing patients. Participants (n=13485) were 57.6 % male, age 28.5 ±7.9, and 63.2% heterosexual. Data was obtained from a large urban STI clinic in the Southwestern United States. Primary analyses consisted of generalized linear modeling (GLM) using two models to evaluate both main effects and time interaction. There was a significant increase in post-intervention PrEP uptake (p <.001). Significant predictors of PrEP uptake included male gender and identification as LGBTQ+ (p <.001). Not Hispanic or Latino and age group of 51-74 showed increased PrEP uptake from 12.1 % to 18.9 % and 12.4% to 21.3% post intervention. Native American Indian and Alaskan Natives improved 3.3 % to 12.7 %. Only marginal increases in PrEP uptake were observed among Black or African Americans, Asians, and White participants. One-way SMS communication served as a cost-effective intervention model and had a positive impact on PrEP uptake within one large urban county. These findings indicate that even with limited data there can be ways to focus awareness campaigns for communities using low-cost alternatives.

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Background

The Human Immunodeficiency Virus (HIV) has affected approximately 38 million people worldwide per 2020 data and 1.7 million new HIV diagnoses occurred in 2019 (Cooper & Barber, 2022). HIV has been present in the United States of America (USA) for nearly four decades (Sullivan et al., 2021), with approximately 700,000 HIV/AIDS- related deaths in the United States alone (Fauci et al., 2019). According to the Centers for Disease Control (CDC) and Prevention there are approximately 1.1 million people currently living with HIV and

15% are unaware of their HIV infection status (Fauci et al., 2019). It is estimated that 69% of new infections are transmitted by persons with HIV who are not under medical care, and about 23% of new infections are transmitted by individuals who are unaware of their HIV infection status (Frieden et al., 2015). Current HIV prevalence and new HIV diagnoses in the USA serve as a proximate demographic indicator of where new infections could possibly occur and provide directions to areas that need HIV prevention the most (Sullivan et al., 2021).

Pre-Exposure Prophylaxis (PrEP)-What is it?

Pre-Exposure Prophylaxis (PrEP) is a prophylactic treatment with medications to prevent HIV transmission. This treatment (PrEP) involves the use of Anti-Retro Viral (ARV) therapy to decrease the risk of acquiring HIV infection. The PrEP treatment for HIV prevention uses a drug combination of Emtricitabine and Tenofovir Disoproxil Fumarate, and was approved by the Federal Drug Administration (FDA) in 2012 as a once a day tablet for adults and was extended to adolescents (over 35kg) in 2018 (Mayer et al., 2018). Multinational clinical studies have shown that PrEP treatments have been highly effective (Muwonge et al., 2019). Other newer novel PrEP agents in the market include Emtricitabine and Tenofovir Alafenamide tablets, long acting once a month injectable Cabotegravir and with other agents such as Saltair are under development (Coelho et al., 2019). Since 2017, PrEP usage has increased 10-fold in the USA to prevent HIV transmission, however there are some geographical disparities in PrEP usage (Sullivan et al., 2019). More than half of the new HIV diagnoses in 2016 occurred in the Southern United States, yet there was very little PrEP usage in that region (Sullivan et al., 2018). Geographic and demographic HIV hotspots need to be PrEP focal points to interrupt the HIV spread. In addition to regional differences in PrEP uptake there are racial differences. While the United States is seeing an increase in PrEP usage, PrEP uptake by Black and Hispanic Americans has decreased (Sullivan et al., 2024). To end the HIV epidemic, the US Department of Health and Human Services (DHHS) has proposed initiatives to address this ongoing HIV public health crisis with the goal of reducing the numbers of new HIV infections in the USA by 75% within 5 years, and then by 90% in the next 10 years (Fauci et al., 2019).

CDC Guidelines for PrEP

The CDC recently released updates to the clinical practice guidelines for PrEP ("CDC," 2021). In these guidelines PrEP is indicated for use in individuals at substantial risk of HIV infection, defined by behavioral criteria including unprotected intercourse (UI) with a partner having an HIV positive status, sexually transmitted infections (STIs), any biological indications of risky sexual activity, or sharing needles or other items with an HIV positive individual. For each criterion, PrEP providers should query these indications over the prior 6 months; any events during the risk window period may trigger a possible indication for PrEP ("CDC," 2021). The CDC supports PrEP use as part of a comprehensive prevention plan, including other biomedical and behavioral prevention strategies. Implementation is moving ahead with the emergence of diverse models of delivery. Health care clinics that test and treat STIs and community-based clinics serve as promising clinical sites for PrEP delivery. As per the CDC guidelines, STI diagnosis is a prominent risk factor for HIV infection, raising awareness and encouraging PrEP use in this population will aid in decreasing new HIV infections.

STI's and HIV

In 2018, chlamydia reached an all-time high of 1.8 million cases, while gonorrhea and syphilis infections increased by 39% and 42%, respectively. During the Pre-COVID-19 pandemic period, the New York times reported a continued increase in STIs including chlamydia, gonorrhea, and syphilis in the US in 2019 (Scott-Sheldon & Chan, 2020). It was reported that there are higher STI rates in women, adolescents, young adults, gay, bisexual, and other men who have sex with men (MSM). This population invariably also becomes the vulnerable group

for new HIV infections (Scott-Sheldon & Chan, 2020). The COVID -19 pandemic period saw a decrease in STI diagnoses and PrEP uptake which could be the result of a myriad of factors including reduced STI care and testing hours, reduced patient visits, socioeconomic factors like job loss, insurance coverage disruption or reduced sexual activity (Rogers et al., 2021).

Technology Based Approaches to Encourage PrEP Uptake

Several technology-based programs have been adopted to increase PrEP access in unique ways. Some evidence based models include PrEP telehealth services and mobile applications that offer PrEP prescribing without in-person visits and the outcomes of these data are promising (Touger & Wood, 2019). Technology-based interventions can bridge the gaps and provide better PrEP care initiation and continuity (Touger & Wood, 2019). Several evidence-based studies focused on using short message service (SMS) communication for PrEP initiation and adherence have shown that text messaging can be a low-burden intervention that improves patient's PrEP initiation and adherence in multiple populations (Moore et al., 2017; Teitelman et al., 2021).

Study Objectives

While SMS messaging has been used for a variety of chronic conditions, in the United States there have been relatively few studies related to SMS messaging and PrEP uptake. A recent systematic review only identified eight studies conducted in the United States and these studies were limited to promoting adherence versus initial use (Kamitani et al., 2024). Additionally, several studies to date have used small sample sizes (McManus et al., 2020; Moore et al., 2017; Muwonge et al., 2019), this project may be the first study that

utilizes a large urban, racially diverse population that is exposed to an SMS intervention designed to raise awareness and enrollment in PrEP uptake. As new PrEP modalities are emerging, the outcomes of this pre-post demographic study will help the sexual health clinic to develop PrEP intervention patterns and, in the future, develop a greater understanding of the long-term patterns of PrEP use in different populations and to develop tele-health models to accommodate people alternating through periods of PrEP use and non-use, as well as switching between dosing regimens or modalities as they become available to end the HIV epidemic. The purpose of the current pre-post intervention study is to find the impact of one-way SMS communication to increase PrEP uptake in non-HIV, STI testing patients in a large southwest urban community.

Methods

This study utilizes a pre and post intervention study design using secondary data obtained from a large STI testing clinic in the southwest United States. Data for this project was collected in a large urban county with a population of over 5 million people, comprised of residents that are 27% Caucasian, 21.1% African American, and 44.1% Hispanic, a medium income of \$73,000, with 16% of the population in poverty. This non-profit foundation-based health and wellness clinic is one of 71 locations across the United States and offers free STI testing with over 97% of participants utilizing the free service so health insurance information was unavailable. All patients that request STI testing must enroll via the Healthvana app for their STI testing which also allows them to view their results through the Healthvana mobile app and 90% of the STI testing data was collected via the Healthvana mobile application. This

application is a clinically integrated telemedicine service mobile application. Participants who visited for HIV and other STI testing from August 1, 2022, to October 31, 2022, at the wellness center did not receive any PrEP intervention one-way SMS communication. Participants who underwent STI testing during November 1, 2022 to January 31, 2023, received one-way SMS PrEP intervention sent via Healthvana which encouraged them to contact a PrEP coordinator and provided the contact number to set up a PrEP appointment with the health care provider at the wellness center. The message also provided a hyperlink from CDC on a PrEP consumer info sheet which has been updated as of March 2024, which they could click on for more detailed PrEP information (CDC, 2024). Intervention procedure was limited to one SMS text attempt after their initial clinic visit for better patient experience. Wellness testing patients who underwent HIV seroconversion received counseling, partner PrEP services, and linkage to HIV primary care. Due to the secondary nature of the data there were no specific inclusion or exclusion criteria except for an HIV positive diagnosis which was an exclusion (n=27). Participants in both the pre and post SMS intervention groups were independent and there was no crossover in testing between the two time periods.

Statistical Analysis

Descriptive and inferential analyses were conducted using SPSS, version 29.0 (IBM Corp., Armonk, NY). Variables were evaluated for normality and measures of central tendency and dispersion were reported (mean and standard deviation) for continuous variables and counts and percentages were reported for categorical variables. Independent variables in the model included age, gender, sexual orientation, and intervention period. Race was not included in

the model due to an inordinate amount of missing data. Age was used as a continuous variable within the regression model, gender was a binary variable for male and female, sexual orientation was binary between heterosexual and LGBTQ+ due to low levels of enrollment in some categories. Primary analysis consisted of using a generalized linear model (GLM) with binary logistic regression with PrEP uptake as the dependent variable. Two models were conducted; the first model included all independent predictors to include the intervention period and model two consisted of the independent predictors with a time interaction. Secondary analysis consisted of evaluating the effect of an STI diagnosis on PrEP uptake as well as detailed analysis of the independent predictors and their association with PrEP uptake. Age was displayed as a categorical variable using slightly modified census categories to better balance categories. Independent predictors were evaluated at all possible levels for that variable compared with PrEP uptake using chi-square associations. De-identified patient data was used, and the study protocol was reviewed and approved as exempt by the South Dakota State University Institutional Review Board (IRB). Missing data was minimal with the exception of race and ethnicity; race and ethnicity were not used in any models; no missing data imputation or replacement was utilized.

Results

PrEP uptake during pre-intervention and post-intervention was studied. Data was analyzed for 13,485 individuals between a pre and post intervention period. The demographic distribution for 7,011 pre-intervention participants and 6,474 post

Table 1. Comparison of Demographics Between Groups (N=13485)

Variable	Pre-SMS Intervention (n=7011) N (%)	Post-SMS Intervention (n=6474) N (%)
Age (M, SD)*	28.6 (7.8)	28.4 (7.8)
Gender		
Male	4024 (57.4)	3739 (57.8)
Female	2981 (42.5)	2732 (42.2)
Unknown	6 (0.1)	3 (0.0)
Race		
Caucasian	2039 (29.1)	1945 (30.0)
African American	3628 (51.7)	3104 (47.9)
American Indian/Alaska Native	122 (1.7)	150 (2.3)
Asian	262 (3.7)	254 (3.9)
Unknown	960 (13.7)	1021 (15.8)
Ethnicity		
Hispanic or Latino	1955 (27.9)	1790 (27.6)
Not Hispanic or Latino	2947 (42.0)	1633 (25.2)
Unknown	2109(30.1)	3051 (47.1)
Sexual Orientation		
LGBTQ+*	2157 (30.7)	2160 (33.4)
Heterosexual	4477 (63.9)	4043 (62.4)
Unknown	377 (5.4)	271 (4.2)
PrEP* Utilization		
PrEP used	833 (11.9)	947 (14.6)
PrEP not used	6178 (88.1)	5527 (85.4)
STI* Diagnoses		
<i>Gonorrhea Results</i>		
Positive	3 (0.0)	10 (0.2)
Negative	7007 (99.9)	6461 (99.8)
<i>Chlamydia Results</i>		
Positive	8 (0.1)	5 (0.1)
Negative	7002 (99.9)	6469 (99.9)
<i>Syphilis Results</i>		
Positive	3 (0.0)	3 (0.0)
Negative	7008 (99.9)	6471 (99.9)

*M=Mean, SD=Standard Deviation, LGBTQ+=Lesbian, Gay, Bisexual, Transgender, Questioning, PrEP=Pre-exposure prophylaxis, STI=Sexually transmitted infection

Table 2. Generalized Linear Model (GLM) and Predictors of PrEP Uptake

Variable	Model 1			Model 2		
	Exp(B)	Confidence Interval	P Value	Exp(B)	Confidence Interval	P Value
Age	1.01	1.00-1.01	0.032			
Gender (Male)	7.48	6.21-8.99	<.001			
Sexual Orientation (LGBTQ)	10.84	9.42-12.47	<.001			
Intervention Period	1.32	1.18-1.48	<.001			
Age*Intervention				.952	.945-.958	<.001
Gender*Intervention				3.58	3.00-4.26	<.001
Sexual Orientation*Intervention				6.32	5.41-7.37	<.001

intervention participants are reported in Table 1. Demographics were consistent across time periods with 11.9% of participants in the pre-intervention period adopting PrEP while 14.6% of participants in the post-intervention period adopted PrEP.

Adjusting for demographic covariates, the SMS intervention was positively associated with increased PrEP uptake in the post-intervention period (OR=1.32, P <.001, CI 1.18, 1.48) (Table 2.). Demographic variables most associated with PrEP uptake over both time periods were patients who were male, and identified as LGBTQ+. For Model 2, using an independent variable interaction with time (intervention period), younger age, male gender and participants who indicated an LGBTQ+ sexual orientation were primary predictors for PrEP uptake (after SMS intervention) with sexual orientation as LGBTQ+ being the strongest predictor for PrEP uptake (OR=6.32, P <.001, CI 5.41, 7.37).

Secondary Evaluation of Demographic Variables

For those in groups that elected PrEP either before or after the intervention, within age categories there was a slight increase in PrEP uptake post intervention among age groups 25-35 years from 53.4% to 56.7% and

36-45 years, it went up from 11.2% to 12%, respectively. A drastic increase in PrEP uptake was seen among those aged 51-74 years, uptake went up from 2.6% to 3.7% which is an increase of 39.2% when comparing groups post-intervention. Males were the overwhelming majority among those that chose PrEP either pre or post intervention. Distribution was stable among racial categories for PrEP uptake either pre or post intervention. Within sexual orientation there was a slight decline proportionally among those that identify as LGBTQ+ however this population continued to be dominant when choosing to engage in PrEP uptake in both pre and post groups (See Table 3. for distributions among demographics and PrEP uptake).

PrEP intervention via SMS did not affect much change among those that received a positive STI diagnosis dropping down from 28.6% to 27.8%. One positive aspect that was found was SMS intervention for PrEP in STI negative patients went up from 11.9% to 14.6% which is a 22.7% increase in PrEP uptake. Examining specific diagnoses, apart from those with a positive syphilis diagnosis those with a chlamydia or gonorrhea diagnosis did not see a significant increase in PrEP uptake.

Table 3. Comparison of Pre and Post PrEP Uptake Within Demographics (N=1780)

Variable	PrEP Uptake Pre-SMS Intervention (n=833) N (%)	PrEP Uptake Post-SMS Intervention (n=947) N (%)
Age		
16-24	245 (29.4)	244 (25.8)
25-35	445 (53.4)	537 (56.7)
36-50	121 (14.5)	131 (13.8)
51-74	22 (2.6)	35 (3.7)
Gender		
Male	772 (93.1)	866 (91.7)
Female	57 (6.9)	78 (8.3)
Race		
Caucasian	308 (37.0)	337 (35.6)
African American	296 (35.5)	289 (30.5)
American Indian/Alaska Native	4 (0.5)	19 (2.0)
Asian	27 (3.2)	28 (3.0)
Unknown	198 (23.8)	274 (28.9)
Ethnicity		
Hispanic or Latino	292 (35.1)	330 (34.8)
Not Hispanic or Latino	358 (43.0)	308 (32.5)
Unknown	183 (22.0)	309 (32.6)
Sexual Orientation		
LGBTQ+*	726 (87.2)	793 (83.7)
Heterosexual	107 (12.8)	154 (16.3)

*LGBTQ+=Lesbian, Gay, Bisexual, Transgender, Questioning

Discussion

This intervention attempted to improve PrEP uptake after a brief SMS-based message delivered via the Healthvana app. Post-intervention results did indicate an increase in PrEP uptake among those visiting the clinic. While the overall increase in PrEP uptake was noted, the results of the analysis provided information about PrEP acceptance among non-HIV STI testing patients and their demographic breakdown before and after the intervention. The outcomes provide a better understanding of the nature of demographics such as ethnicity, age, race, gender, or sexual orientation, which might be used to better focus PrEP awareness in communities. Ethnicity for example, showed that Not Hispanic or Latino groups showed higher PrEP uptake than Hispanic and unknown groups, emphasizing increased PrEP need for culturally and linguistically appropriate PrEP awareness campaigns among the Hispanic or Latino population. The findings illustrate ethnicity related disparity is consistent with previous research (Raifman et al., 2019). Despite being the most represented racial group in the population, demographic analysis showed only a slight increase in PrEP among the Black or African American population which is not inconsistent with known issues surrounding PrEP and race (Bush et al., 2016).

Awareness regarding PrEP should be more focused and may require tailored messaging using trusted messengers or other effective approaches as the rate of new HIV diagnosis is 4.6 times higher for African American men compared to White men (Sullivan et al., 2018). The substantial increase in PrEP uptake among American Indian or Alaska Native populations may have useful implications in PrEP awareness campaigns in states with high AI/AN populations and it has been demonstrated that

cell phone use is still very high among those with lower socio-economic status, and living in very remote or rural regions (Waller et al., 2019). In this study those who identified as LGBTQ+ showed the highest PrEP uptake post intervention compared to those who did not identify as LGBTQ+. Their PrEP uptake was consistent both pre and post intervention, however over both study periods this only accounted for 30.6% of the total LGBTQ+ community within the dataset indicating more awareness of PrEP uptake may be necessary.

In the county where these data were collected, the prime age group for new HIV diagnosis is between 13-24 years and 25-34 years ("Houston Health Department and Ryan White Planning Council Office of Support. HIV in the Houston Area: 2024 Epidemiologic Supplement for HIV Prevention and Care Services Planning. Houston Health Department. ," 2024). The PrEP uptake showed a slight decrease in ages 16-24 but nice improvement for those 26-35 years, indicating the need for more studies such as health behavior change studies to identify effective approaches to influence uptake among younger populations. In contrast a higher PrEP uptake was found among age group 51-74 years showing that acceptance of risk had lowered and trust in treatment was higher. Lastly, females had lower PrEP uptake compared to males post intervention, again identifying areas of weakness that can be prioritized in future awareness campaigns.

Combined STI outcomes, or patients who were positive for at least one STI infection namely Syphilis, Gonorrhea, and Chlamydia, and their PrEP uptake patterns provided surprising outcomes with patients who tested positive for at least one STI showing a decline in PrEP uptake, whereas STI negative patients increasingly opted for PrEP after the intervention. While this finding related to those who tested positive to an STI seems

counter-intuitive, it is consistent with previous findings (Wagner et al., 2023) and is not unusual for those that start PrEP to have an increase in STI rates (McManus et al., 2020; Montaña et al., 2019; Nguyen et al., 2018). There is however encouraging evidence that SMS related interventions can at least drive interest in and initiate conversations about PrEP (Zucker et al., 2024). Within this large study sample there were small numbers of positive STI diagnoses and most results were negative. The fact that even among those that were negative that they still chose PrEP uptake is encouraging but more work needs to be done with those who test positive initially.

Limitations

There could be several factors that could have contributed to increased or decreased PrEP uptake based on the statistical outcomes and their limitations. One factor could include the period of the SMS intervention, it happened during the months of Nov 2022-Jan 2023, around the prime holiday season, with higher possibility of travelling and holiday season making it difficult to make new PrEP appointments. The lack of additional or complete demographics such as race and ethnicity or key factors, such as income, education, insurance status, transportation needs, as well as social and cultural support and beliefs can be important predictors that can impact outcomes (Schiller et al., 2012). Additionally, the truncated nature of the time frame for the data made more sophisticated analysis such as interrupted time series analysis (ITS) or other longitudinal modeling potentially unreliable (Penfold & Zhang, 2013). Even though efforts were initiated to mitigate, there may be the possibility of overfitting due to the number of variables with interaction terms. Additionally, the binary nature of the predictors or the continuous nature of the age

variable may contribute to potential confounding or the inability to identify cut-points which may be useful for identifying PrEP uptake. Future studies using longer time periods with more demographic information available are recommended.

Health Behavior Implications

The study aimed to look at the effect of a one-way SMS PrEP promotional activity for an STI wellness center in a large urban southwestern county. One-way SMS communication served as a positive impact on Non-Hispanic or Latino populations, American Indian or Alaskan Native populations and patients in age group of 51-74 years. Overall, the project did increase PrEP uptake in the post-intervention period as well as for those with a negative STI diagnosis but whom may still be high-risk for HIV. The study identified gaps among Hispanic or Latino ethnicity, Black or African American race, bisexual, females, lesbian, and STI positive populations. Different PrEP intervention strategies focusing on the above vulnerable populations should be the focal point in awareness programs. More measures to address their health disparities are needed. Tailored PrEP uptake approaches aimed at these vulnerable populations may help curb the disproportionate rise of new HIV infections.

Ethical Approval

The study was determined to be exempt by the Institutional Review Board at South Dakota State University.

Conflict of Interest

The authors have no conflicts of interest to declare.

Discussion Questions

There is strong evidence to support the correlation between a positive STI diagnosis and subsequent PrEP uptake. What may be some factors that might affect those with an STI positive diagnosis not electing PrEP?

Despite Black or African American men and women being well-represented in our study sample, what recommendations would you propose to increase awareness regarding PrEP within this community?

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