Text messaging intervention for Pap smear uptake: a single-institution study

Namita Bhardwaj[1,2]^, Andrew T. Herndon[3]^, Yong-Fang Kuo[4]^, Laura R. Porterfield[1]^

[1]Department of Family Medicine, The University of Texas Medical Branch, Galveston, TX, USA; [2]Department of Orthopaedic Surgery and Rehabilitation, The University of Texas Medical Branch, Galveston, TX, USA; [3]Community and Population Health, The University of Texas Medical Branch, Galveston, TX, USA; [4]Department of Biostatics and Data Science, The University of Texas Medical Branch, Galveston, TX, USA
Correspondence to: Namita Bhardwaj, MD, MS, MPH. Department of Family Medicine, The University of Texas Medical Branch, 301 University Blvd., Galveston, TX 77555-1123, USA; Department of Orthopaedic Surgery and Rehabilitation, The University of Texas Medical Branch, Galveston, TX, USA. Email: nabhardw@utmb.edu.

Abstract: Cervical cancer continues to be one of the leading causes of death among women in many parts of the world. With the increasing proliferation of mobile technology, text messaging interventions have been effective in improving Pap smear uptake in non-United States populations. This study evaluated whether text message reminders from a health system in Galveston, Texas, USA increased uptake of cervical cancer screening as compared to usual care. A single text message reminder was sent to 16,002 unique patient phone numbers using the Televox Communication Program from February 20, 2019, to April 4, 2019. The institution's population health database was subsequently used to determine if patients received cervical cancer screening (Pap smear) following the text message transmission. Patient demographics within text message and control groups were compared using Chi-square tests. Our text messaging intervention to improve Pap smear rates did not show a statistically significant difference between the intervention group receiving a text message and the control. However, there were significant interactions between text messages and age, financial class, and county (P=0.0023, 0.0299, and <0.0001, respectively). Text messaging did have a positive impact on our most vulnerable patient populations given that the text messaging intervention showed a marginally higher rate of Pap smear among Medicaid and low-income/uninsured (MLIU) patients. Text messaging interventions do have effectiveness in increasing Pap smear uptake in populations which are most impacted by health disparities.

Keywords: Text messaging; health outcomes; cervical cancer screening; population health

Introduction

Identifying effective approaches for improving cervical cancer screening rates is a key priority in the USA and globally. Despite the development of effective vaccines against human papillomavirus (HPV) (1) and despite the availability of an effective option for cervical cancer screening (2,3), cervical cancer continues to be a leading cause of cancer death in women in many parts of the world (4) and is an area of significant disparities based on socioeconomic status, and place of residence in the USA (4-6). The coronavirus disease 2019 (COVID-19) pandemic has caused further setbacks in HPV immunization and cervical cancer screening and treatment both in the USA and worldwide (7-10). These setbacks highlight the need

for proactive approaches to reach populations with lower uptake of cervical cancer screening.

One potential approach to increasing cervical cancer screening uptake that has been found effective in other countries is the use of text message outreach (11). Studies around the world have found text messaging to be effective at increasing routine cervical cancer screening uptake both alone (12,13), and in combination with other measures, including reminder letters (14) health education programs (15), phone calls (15-19), face-to-face interviews (19), video attachments (19), extended hours (19) and transportation vouchers (20). Qualitative studies in the USA have shown high satisfaction with text message reminders about cervical cancer screening in African American (21) and Korean populations (22). Text messaging has also been shown to be effective in increasing rates of colonoscopies in the veteran population in the USA (23). However, a current literature gap exists in addressing whether text messages are effective in a USA context for increasing routine cervical cancer screening in average-risk women.

This study took place in Texas, where cervical cancer incidence is the fifth highest in the USA (9.4 cases per 100,000 compared to the national average of 7.7 cases per 100,000), and where cervical cancer screening rates are in the bottom quartile of states (75.44% compared to the USA average of 77.9%) (2). Given the low cervical cancer screening rates, we sought to evaluate whether text message reminders would increase the uptake of cervical cancer screening as compared to usual care.

Methods

Study design

The study was a retrospective case-control study evaluating the effectiveness of a text messaging intervention on the uptake of cervical cancer screening at a single institution.

Human subjects

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was reviewed by the Institutional Review Board of the University of Texas Medical Branch (FWA#: 00002729) as a quality improvement/quality assessment project and did not meet the definition of "human subjects research" and therefore did not require IRB approval or oversight. Individual consent for this retrospective analysis was waived.

Study setting and participants

Study participants were selected from our institution's registry of patients that were due or past due for a Pap smear. The study population was limited to patients residing in Galveston, Brazoria, and Harris counties, and included both commercially-insured and Medicaid and low-income/uninsured (MLIU) patients. Participants were selected for receipt of text messages from a sample of patients who had opted-in to receive text message alerts in the last year. To be selected for a text message, a patient must: (I) have text message listed as a communication preference on file; (II) have a first language as English on file; and (III) be overdue for a Pap smear.

Variables, data sources and study size

A single text message reminder was sent to 16,002 unique patient phone numbers using the Televox Communication Program from February 20, 2019 to April 4, 2019. The text message stated the following: "[Institution Name]: Our records show you are overdue for a Pap smear. Please call [phone number redacted] to schedule an appointment." Approximately 90% of the text messages were transmitted successfully to patients.

We then ran the patients who had been eligible for cervical cancer screening through the institution's population health database to inquire if they received a Pap smear following the text message transmission. If they had received a Pap smear between May 24, 2019 and December 31, 2019, the order date for the Pap smear lab must have taken place after the text message date and only completed/resulted orders were selected for the performance group. We allowed a six-week lag time from the intervention start date to allow for time for patients to schedule the appointment based on receipt of a text message. External Pap smear orders integrated through a regional health information exchange (HIE) with our electronic medical record (EMR) system were not included in this study. We excluded 843 patients who had Pap smear orders before May 24, 2019 and 133 patients with missing data on demographics, resulting in n=15,026 patients in the text message group.

The control group was comprised of patients who were due for a Pap smear but did not receive text message alerts in 2019. They were identified as patients who did not have "text message" listed as a communication preference on file. Among 53,177 patients in the control group, 92 who had

Table 1 Patients characteristics stratified by those receiving text message

Characteristics	Category	Text message				P value
		Yes		No		
		n	%	n	%	
Total		15,026	22.1	53,085	77.9	
Age (years)	<30	2,632	17.5	15,659	29.5	<0.0001
	30–39	2,928	19.5	12,756	24.0	
	40–49	3,077	20.5	11,391	21.5	
	≥50	6,389	42.5	13,279	25.0	
Financial class	MLIU	6,943	46.2	32,799	61.8	<0.0001
	Non-MLIU	8,083	53.8	20,286	38.2	
County	Galveston	8,271	55.0	20,463	38.5	<0.0001
	Harris	2,902	19.3	8,182	15.4	
	Brazoria	3,579	23.8	8,785	16.5	
	Others	274	1.8	15,655	29.5	

MLIU, Medicaid and low-income/uninsured.

missing demographic data were excluded. The population health database was also used to identify patients who received a Pap smear in the control group between January 1, 2019 and July 8, 2019. We selected this time window to ensure both groups had the same amount of time to receive a Pap smear.

Statistical methods

Patient demographics within text message and control groups were compared using Chi-square tests. The demographic factors examined were financial class, county and age (<30, 30–39, 40–49, and ≥50 years). For financial class, patients were classified as either MLIU patients, or non-medically underserved (non-MLIU). Proportions of patients receiving cervical cancer screening were compared between the two groups and stratified by demographics were reported. A logistic regression analysis was performed to examine the association between receiving a text message reminder and completing cervical cancer screening, controlling for financial class, county and age. To evaluate whether the effect of text messaging varied by demographics, we tested the interaction between text messaging and each covariate in the logistic regression model. All analyses were performed in the SAS software application (version 9.4: SAS Institute, Cary, NC, USA).

Statistical tests were two-tailed and significant set at an alpha level of 0.05.

Results

Compared to patients in the control group, the patient population receiving a text message had a higher proportion of individuals aged ≥50, who were non-MLIU, and who resided in Galveston County (*Table 1*). Overall, the rates of Pap smear were similar between the two groups (6.93% in the text message group *vs.* 7.30% in the control group), even while controlling for demographics (OR: 1.05, 95% CI: 0.97–1.13) (*Table 2*). However, we found significant interactions between text message and age, financial class, and county (P=0.0023, 0.0299, and <0.0001, respectively). The stratified models showed the effect of text messaging on receiving a Pap smear was significantly higher among patients younger than 30 (OR: 1.21, 95% CI: 1.05–1.39), and among patients residing in Galveston County (OR: 1.15, 95% CI: 1.04–1.27) (*Table 3*). The effect of text messaging on completing cervical cancer screening was marginally significant for MLIU patients (OR: 1.11, 95% CI: 0.99–1.23, P=0.0663). On the other hand, we found the effect of text messaging on receiving a Pap smear was significantly lower among patients aged 30–39 (OR: 0.80, 95% CI: 0.70–0.93) and among patients residing in Harris

Table 2 Characteristics associated with receiving Pap smear

Characteristics	Category	% receiving Pap smear	Multivariable analysis	
			OR	95% CI
Text message	No	7.30	1.00	
	Yes	6.93	1.05	0.97–1.13
Age (years)	<30	9.91	1.00	
	30–39	9.90	1.01	0.94–1.08
	40–49	5.37	0.53	0.49–0.58
	≥50	3.95	0.38	0.34–0.41
Financial class	MLIU	7.09	1.00	
	Non-MLIU	7.40	1.11	1.04–1.18
County	Galveston	7.27	1.00	
	Harris	10.56	1.36	1.26–1.46
	Brazoria	5.60	0.74	0.68–0.81
	Others	6.06	0.84	0.77–0.91

MLIU, Medicaid and low-income/uninsured; OR, odds ratio; CI, confidence interval.

Table 3 Difference on receiving Pap smear between those with and without text message at subgroups

Characteristics	Category	Text message				Multivariable analysis	
		Yes		No		OR	95% CI
		n	%	n	%		
Age (years)	<30	282	10.7	1,531	9.8	1.21	1.05–1.39
	30–39	266	9.1	1,286	10.1	0.80	0.70–0.93
	40–49	196	6.4	581	5.1	1.08	0.91–1.28
	≥50	298	4.7	478	3.6	1.13	0.97–1.32
Financial class	MLIU	502	7.2	2,316	7.1	1.11	0.99–1.23
	Non-MLIU	540	6.7	1,560	7.7	1.00	0.90–1.11
County	Galveston	627	7.6	1,461	7.1	1.15	1.04–1.27
	Harris	207	7.1	964	11.8	0.71	0.60–0.83
	Brazoria	186	5.2	507	5.8	1.16	0.97–1.39
	Others	22	8.0	944	6.0	1.28	0.81–2.02

MLIU, Medicaid and low-income/uninsured; OR, odds ratio; CI, confidence interval.

County (OR: 0.71, 95% CI: 0.60–0.83).

Discussion

Key findings

Our text messaging intervention to improve Pap smear rates as a whole did not show a statistically significant difference between groups who received a text message and those who did not. When compared to other studies (11), text messaging was not as effective at increasing Pap smear uptake but did have a positive impact on our most vulnerable patient populations given that the text messaging

intervention showed a marginally higher rate of Pap smear among MLIU patients.

Most of the studies that have shown positive results in increasing cervical cancer screening rates included other interventions in addition to text messaging. The studies that involved only text messages included multiple messages over the course of the study (12,13). It may be that a single text message alone is ineffective in increasing cervical cancer screening but that multimodal interventions including multiple text messages and other interventions such as phone calls, education, or transportation vouchers would yield results similar to those in other countries. Further studies are needed to identify whether serial text messages and multimodal interventions would be effective in a USA context for increasing cervical cancer screening. While a number of other studies have shown an increased uptake in international settings (14-20), only one study in our literature search found text messages to be effective for increasing annual cervical cancer screening in a USA context, specifically for women living with HIV in Nevada (21). A study on migrant Chuukese women in Guam did not find text messaging to be effective in increasing cervical cancer screening uptake (24). A study by Le and Holt found that focusing on a spiritually-based text message about the risk of cervical cancer had high acceptance among African-American women and helped to increase their knowledge about cervical cancer (21). To our knowledge, this is the first study that has evaluated the effectiveness of text messages in increasing cervical cancer screening uptake in an average-risk population in the continental USA.

Limitations

There are limitations to our study. Our study focused on a text messaging intervention at a single institution, which limits its generalizability. Further, patients may have received cervical cancer screening through other health systems after the text message reminders. Our study was limited to English speakers and those who had the capability to receive text messages, further limiting generalizability. Text messages were only sent once, without repeated reminders, and a 90% transmission rate does not necessarily mean 90% uptake. Our study only evaluated a limited number of demographic factors given the availability of data collected by our population health database. Exploration of other demographic factors may be addressed in future projects evaluating the efficacy of text messaging interventions in different populations. These

factors can contribute to selection bias in our study.

Conclusions

Text messaging has been shown to improve preventive health care screenings in international contexts and among high-risk populations in the United States. Our single-institution study illustrates that a pre-COVID text messaging intervention did have success in improving Pap smear uptake among those who are younger than 30 and resided in Galveston County, the location of the majority of our hospital system's clinics. It also showed a marginally significant uptake among our most vulnerable patient populations (MLIU). Future research should evaluate text messaging interventions post-COVID-19 with multi-institutional involvement and further diversification of text message interventions to include different topics and languages.

Footnote

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was

conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was reviewed by the by the Institutional Review Board of the University of Texas Medical Branch (FWA#: 00002729) as a quality improvement/quality assessment project and did not meet the definition of "human subjects research" and therefore did not require IRB approval or oversight. Individual consent for this retrospective analysis was waived.

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