

Increasing Uptake of Cervical Cancer Screening Through Text Messaging

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A DNP Project Manuscript
Submitted in Partial Fulfillment of the Requirements for the
Doctor of Nursing Practice Degree

School of Nursing, University of Maryland, Baltimore
May 2024

Author Note

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Abstract

Problem: Cervical cancer (CC) is one of the most common cancers affecting women. Incidence of CC is significantly reduced through regular and timely cervical cancer screening (CCS). In the US, rates of overdue CCS increased from 14% in 2005 to 26.1% in 2021. A nurse practitioner (NP)-owned primary care clinic in the Mid-Atlantic experienced inadequate tracking and timely uptake of CCS. Baseline data showed 17.6% of 21–29-year-olds and 22.1% of 30–65-year-olds were overdue for CCS with only 12.7% having a documented CCS in the electronic health record (EHR). This sub-optimal tracking and detection increases opportunities for patients to miss CCS.

Purpose: The purpose of this quality improvement initiative was to increase CCS uptake among clinic patients through text message invitations to schedule an appointment or obtain a referral.

Methods: A new policy standardizing identification, contact, and tracking of soon-due and overdue CCS patients was created. The new workflow sent two text message reminders to patients 21–65 years old who were soon-due or overdue for CCS. Participants were determined by EHR report to include age, sex, history of hysterectomy, and date of last pap smear.

Results: 46 patients participated in the project. Of the text messages sent, 32.6% (n=15) responded. 33.3% (n=5) of respondents scheduled their CCS and of those, 60% (n=3) completed it during implementation. 33.3% (n=5) reported an up-to-date CCS. Post-intervention rates of overdue CCS were 13.7% for 21–29-year-olds and 14.5% for 30–65-year-olds, a 3% and 7% improvement. Overall, an 85.8% CCS compliance rate was seen post-intervention.

Conclusions: Findings suggest the use of text messaging reminders is a low cost, low barrier way to increase uptake of CCS in this setting. Addressing barriers and organizational processes may help increase patient response to text messaging and increase timely uptake of CCS.

Keywords: Cervical cancer screening, cancer prevention, text message, primary care

Increasing Uptake of Cervical Cancer Screening Through Text Messaging

Cervical cancer (CC) is the one of the most common cancers affecting women worldwide. It is also one of the most preventable diseases with over 95% attributed to the human papillomavirus (HPV) (World Health Organization [WHO], 2022). In the United States (US), the Centers for Disease Control and Prevention (CDC, 2022a) estimates there are almost 13,000 new diagnoses and 4,000 deaths annually with a mortality rate of 2 per 100,000 as compared to the global mortality rate of 13.3 per 100,000. This notable difference can be attributed to HPV vaccinations and regular cervical cancer screenings (CCS), with timely management as indicated by the United States Preventive Services Task Force (USPSTF) and the American Society of Colposcopy and Cervical Pathology's guidelines (Perkins et al., 2020; USPSTF, 2018; WHO, 2022). Current USPSTF (2018) guidelines recommend screening women ages 21-29 every 3 years with cervical cytology and women ages 30-65 "every 3 years with cervical cytology alone, every 5 years with high-risk human papillomavirus (hrHPV) testing alone, or every 5 years with hrHPV testing in combination with cytology (co-testing)."

Even with these guidelines, the U.S. Department of Health and Human Services (HHS, 2021) reported that 26.1% of women were past due on their CCS, a 12.1% increase from 2005. Additionally, end stage CC is increasing, particularly in women in their 30s and 40s and in Caucasian women (Francoeur et al., 2022; Suk et al., 2022). In line with these statistics, a small nurse practitioner (NP)-owned primary care clinic in the Mid-Atlantic experienced inadequate tracking and timely uptake of CCS, as noted by clinic providers and site baseline data. Baseline site data showed 17.6% of 21–29 year-olds and 22.1% of 30–65 year-olds were overdue for CCS, however, only 12.7% had a documented CCS in the electronic health record (EHR). Root causes most responsible for this problem include the lack of a CCS tracking policy or

standardized workflow, inability to obtain complete medical records and ensure they were completely inputted into the electronic health record (EHR), provider and staffing burnout, changes, and shortages, and the lack of more in-depth EHR training (see Appendix A).

Available Knowledge

Suk et al. (2022) found that the predominant reason patients in the US were overdue on their CCS was due to not knowing that they were overdue for the screening. To address the inadequate tracking and timely uptake of CCS in this clinic setting, evidence from six randomized controlled trials (RCT) and one systematic review demonstrated that text message reminders or invitations for scheduling via text message were an effective, low-cost, and easily accessible intervention that improved preventative healthcare screening uptake rates, including CCS. This body of evidence was rated I B, good and consistent evidence (Dang et al., 2018).

All studies analyzed the same outcome: rates of uptake of CCS when using text message reminders or appointment schedulers within text messaging form. Overall baseline demographics were limited in five of six experimental studies, including notable differences in participant ages, which could negatively affect generalizability, however Uy et al. (2017) encompassed all age ranges, helping to strengthen the evidence. All studies were done in the US or Europe, increasing generalizability to high-income-country health systems. Intervention protocols were similar in all but two studies strengthening internal validity. They used text messaging to invite patients to schedule their cancer screening appointment with limited follow up to help schedule if no initial response. Only one of the experimental studies had an adequate sample size due to no power analysis conducted or inadequate sample size in the other studies. This could affect internal and external validity and potentially weaken the strength of the evidence. This said, the results of all studies in the evidence review showed statistical increases in CCS uptake when using text

messaging interventions, adding validity and strength to the evidence. While individually the clinical significance of the results was small, taken as a whole, the evidence was strengthened. Additionally, the intervention was low-cost, low risk, and once implemented, minimal staff attention was needed to maintain the intervention. Because the majority of the patient population at the clinical site own mobile phones, this proved to be an effective tool to increase uptake of CCS. For full evidence review and synthesis, see Appendices B & C.

The purpose of this quality improvement (QI) initiative was to implement the use of text message reminders with invitation to schedule an appointment or to obtain a referral to optimize CCS among patients at a small, NP-owned primary care practice. The structure goal for this initiative was the implementation of a new CCS documentation and tracking policy, the process goal was to send CCS text message reminders to all eligible patients, and the primary outcome goal was to meet the Healthy People 2030 national target rate for timely CCS for all eligible clinic patients (79.2%).

Rationale

The process framework, Promoting Action on Research Implementation in Health Services (PARiHS) was chosen to guide implementation of this QI project. This framework aids in facilitating research findings into clinical practice, also called knowledge translation. Per the framework, the three factors that affect successful knowledge translation are evidence (E), context (C), and facilitation (F). From this, a simple equation is made to demonstrate the framework: “ $SI = f(E, C, F)$ where SI=successful implementation and f=function of” (Kitson et al., 1998, p. 150; See Appendix D).

The three factors can each be broken down into subfactors, all playing equal roles in the success of the project implementation with high and low qualities represented in each. The factor

Evidence includes research, clinical expertise, and patient preference as its sub-factors where high quality research is favored, however clinical and patient buy-in can play a huge role in implementation success. The factor Context encompasses the organizational setting and what factors affect, positively or negatively, the proposed implementation and includes culture, leadership, and measurement within the organization as its sub-factors. The factor Facilitation refers to the facilitator or leader who is working to ease the burden on others in the organization and includes characteristics, role, and style of the leader as sub-factors. Each sub-factor is on a high (positive attributes)-low (negative attributes) continuum and depending on where the organization of implementation falls on the continuum and in the three-factor matrix will ultimately affect the intervention outcomes positively or negatively (Kitson et al., 1998).

The PARiHS framework's consideration of the three factors and their sub-factors provided structural support to the project site and staff as the clinic prepared for implementation. It encompassed many aspects of implementation that otherwise may have been overlooked, such as provider and patient preference, culture, and a facilitator's style and characteristics including empathy, respect, and credibility.

Methods

Context

Contextual elements including setting, culture, climate, and resources were evaluated for change readiness. The site was an NP-owned primary care clinic located in a large, urban area, accessible by car and public transit. Operational and financial decisions were made by the NP owner of the practice. The clinic staff included one full time (owner) and one part-time nurse practitioner, one office manager, and three part time office staff who coordinate scheduling, billing, and triaging patients via text message or patient portal. The practice was about five years

old and since hiring its second NP last year expanded its patient load significantly. Staffing changes and shortages, financial pressures, and facilities issues were present prior to and during implementation which contributed to stress on the providers and staff. Additionally, the clinic adopted a new web based EHR to manage medical record documentation about one year ago, with some patient information from the old system, such as preventative screenings, not being transferred over. Lastly, as a small, provider-owned clinic, providers and staff were open to and excited for evidence-based practice change and were willing to put financial and staff resources towards these changes. The development of standardizing patient care policies and procedures was not previously a priority, therefore performing, documenting, and tracking preventative healthcare screenings such as CCS were not standardized.

Intervention

The 12-week QI initiative took place from October 2023 through January 2024, impacting 46 patients. The initiative involved implementing a standardized workflow process to identify, contact, and track clinic patients who were soon due and/or overdue for their CCS. Preceding implementation, the Doctor of Nursing Practice (DNP) student QI Project Lead (QI-PL) developed a site-specific CCS policy with the clinic NPs to standardize the CCS process at the clinic. The new process involved the deployment of no more than two text message reminders sent to patients 21-65 years old with a cervix who were soon-due or overdue for CCS, including follow up reminder messages. Soon-due and overdue clinic patients were determined by EHR report to include patient age, patient sex, history of hysterectomy, and date of last pap smear. The text message content was developed by the QI-PL and the clinic NPs based on the USPSTF guidelines.

During the first week of implementation, the policy was distributed to clinic providers and staff via email and paper handouts, with in-person or virtual training provided by the QI-PL to communicate the scope of the initiative, new clinic procedures, and methods to measure the impact of the QI initiative. Reminder signs were put in each exam room to prompt providers to ask patients about their last CCS and other preventative screenings. Starting in week two, the text message intervention went “live” with message deployment by a clinic scheduler and QI-PL through an existing HIPAA compliant, secure patient messaging system to eligible patients (21-65 years old with a cervix) who are overdue or soon due for CCS. The office scheduler and the QI-PL managed all text message initiation and communication with patients. Documentation of communication was done by the office scheduler and QI-PL into a password protected spreadsheet file, on a password protected computer, in a locked office. Patients selected their follow up preferences which included: opt out, schedule CCS at office, request GYN referral, or currently up to date on CCS via another provider. If a patient failed to respond to the initial text message, a follow up text message was sent two weeks later. See Appendix E for current and desired process maps.

Measures and Study of the Intervention

Chart audits were conducted weekly by the QI-PL on clinic patients, 21-65 years old with a cervix, soon-due or overdue for CCS. These were based on USPSTF guidelines using an EHR generated patient roster showing date of last CCS to retrieve demographic information and scheduling/referral data via a password protected spreadsheet file on a password protected clinic office computer showing message deployment and response data (Appendix F for specific elements). Text message verbiage was reviewed and modifications to decrease and simplify

verbiage were made in weeks three and four. Staff were audited monthly, and feedback was given as needed.

The measures for this DNP project were evaluated to determine impact at the process and outcome levels. The project required a change in process through the standardization of provider and clinic staff EHR workflow. The process measure was evaluated through completion of the standardized CCS text messages sent to all eligible patients by clinic staff or QI-PL per the new clinic policy. A text message is operationally defined as “the act of sending short, alphanumeric communications between cellphones, pagers or other hand-held devices, as implemented by a wireless carrier” (Mathias, 2023). The outcome goal of meeting the Healthy People 2030 target goal for timely CCS uptake (79.2%) for all eligible clinic patients was measured pre- and post-implementation through chart audit and EHR data extraction to assess for rate change and to compare to target goal.

Ethical Considerations

The determination of non-human subject’s research from the Human Research Protections Office of the University of Maryland School of Medicine Institutional Review Board (IRB) was attained prior to the implementation of this QI project. REDCap was employed to manage data collected during this project implementation and data analysis. There were no identified potential conflicts of interest. Aggregated data across the 12-week initiative was shared with the site to assess project efficacy and achievement of goals. External dissemination would occur with site approval.

To protect privacy, text messages were sent using the HIPAA compliant, secure patient messaging system on a password protected computer. To protect data confidentiality, all data were managed by only the QI-PL, stored in REDCap, an encrypted, password protected data

management software program, HIPAA compliant, cloud-based server. Patients were associated with an ID number, with the code key kept separately and securely in a password protected file on the QI-PL's password protected computer. The QI-PL used a side-by-side screen method in a HIPAA secure, private location within the clinic during chart audits to enter coded data into REDCap. Data were analyzed weekly by the QI-PL and reported in aggregate to the site team to track project impact.

Results

Results from this 12-week QI initiative found that of the 49 patients who were eligible for the initiative, 93.8% (n=46) were sent the text message intervention, nearly meeting the initiative's structural goal. Of those who participated, almost one-third responded to the text message intervention (n=15, 32.6%), over half after the second message (n=8, 53.3%). Of those who responded, 66.7% (n=10) were in the 30–65-year-old age group. With regard to CCS, one third (n=5, 33.3%) of respondents scheduled their CCS at the clinic or with a gynecologic practice and 60% (n=3) of those who scheduled completing their CCS prior to the culmination of the project's implementation phase. Another 33.3% (n=5) of respondents reported an up-to-date CCS, bringing them into compliance with USPSTF CCS guidelines. Post-intervention rates of overdue CCS were 13.7% for 21–29-year-olds and 14.5% for 30–65-year-olds, a 3% and 7% improvement, respectively, from baseline. These rate improvements exceeded the outcome goal to meet the Health People 2030 goal of 79.2% of eligible 21–65-year-old persons with a cervix having an up-to-date CCS per USPSTF guidelines with an 85.8% compliance rate (Appendix G).

Chart audit of response rates from weeks two and three showed there was an eight percent response rate in week two and a zero percent response rate in week three. Due to this, leadership and the QI-PL modified and updated the text message verbiage to shorten and

simplify the messages which were sent out to participants starting in week four. A scheduling link via the clinic website was given in the updated text verbiage. Week four showed an improved response rate of 20% after reminder text messages were sent to the original week two group. Staffing changes in week 10 required the QI-PL to assume text messaging responsibilities. This change showed a median text message response rate of 43.75% for the last two weeks of the initiative. Analysis was unable to determine variations in the data due to special cause as a result of a lack of trends, runs, or shifts observed in the data. Common cause variations in the data included providers prioritizing more pertinent data collection during patient visits, staffing shortages and changes, and time constraints.

Discussion

The implementation of text messaging reminders inviting patients to schedule a CCS appointment or obtain a gynecologic referral demonstrated improved rates of CCS in clinic patients of both age groups. Overall, the clinic's CCS compliance rate of 85.8% surpassed the outcome goal for this project, the national Health People 2030 CCS compliance target rate, by 6.6%. The results are consistent with outcomes observed in the literature that showed increased CCS uptake after text message reminders were sent in the primary care setting (see Appendix B). Additionally, the change in text message verbiage to a shorter, simpler message before week 4 text messages were sent garnered a positive response rate. This is consistent with Huf et al. (2020) who found that simpler verbiage produced a larger response rate from CCS eligible participants. Furthermore, text messaging is a lower cost intervention than other reminder modalities, such as sending letters in the mail, and was seen in the literature to reduce clinic financial burden of ensuring CCS compliance in patients by approximately \$0.75 per message reminder sent (Firmino-Machado, et al.,2018). Due to its low cost and simplicity of

implementation, as demonstrated in this QI project, there is significant potential for this to be easily replicated in the primary care setting for CCS and other conditions with recommended screening intervals.

A notable difference in anticipated and actual text message responses came during weeks five to 10, in which there were no responses from participants. With a lack of trends or shifts in the data, it is hard to pinpoint the actual cause, however, one possible cause is the timing of the QI project implementation. Weeks five through 10 were exactly the time between Thanksgiving and New Year's Day. During this time of year, many people could have been focused on planning for holidays and end of year events, deprioritizing health related issues until January.

Factors that might have limited interval validity include lack of verification that the patient was previously seen at the clinic. Due to the clinic's subscription with an online scheduling platform, patients can register online for an appointment and a chart is created in the EHR. This EHR populates the data reports used in the intervention, which was laborious for the staff and QI-PL to conduct, especially with a lack of in-house IT support. Another factor limiting internal validity includes staffing changes and shortages contributing to differences in timing of text messages sent. Additionally, with no standardized response to patients who did respond to the text message intervention, there is potential for variation in outcome.

Conclusion

Findings from this QI project suggest the use of text messaging reminders is a low cost, low barrier method to increase CCS uptake in this setting. Consistent with the evidence, these findings help to improve detection of and survival from cervical cancer and improve clinic quality measures. Due to its simple design, it has potential for easy replication in the primary care setting. A few important takeaways were learned from this initiative. First, the importance

of simple text message verbiage, with a scheduling link embedded in the text message can help to increase responses from participants. The second is the impact the staffing changes and shortages can have on the success and functionality of the initiative. This is coupled with provider time constraints and clinic financial constraints affecting initiative success. Until resolved, these factors will continue to limit the operation and sustainability of the initiative.

Future QI initiatives should consider assessing the standardizing system used to identify and track CCS. Since many patients are overdue on their CCS due to not knowing when their last CCS was and/or how often they should be getting their screening, this will help to better streamline the process and ensure eligible patients do not get overlooked. Additionally, addressing limiting factors through deletion of patients in the EHR who were not actually seen at the clinic and consideration for the season in which the initiative is implemented may help increase patient response to text messaging and ultimately increase timely CCS uptake.

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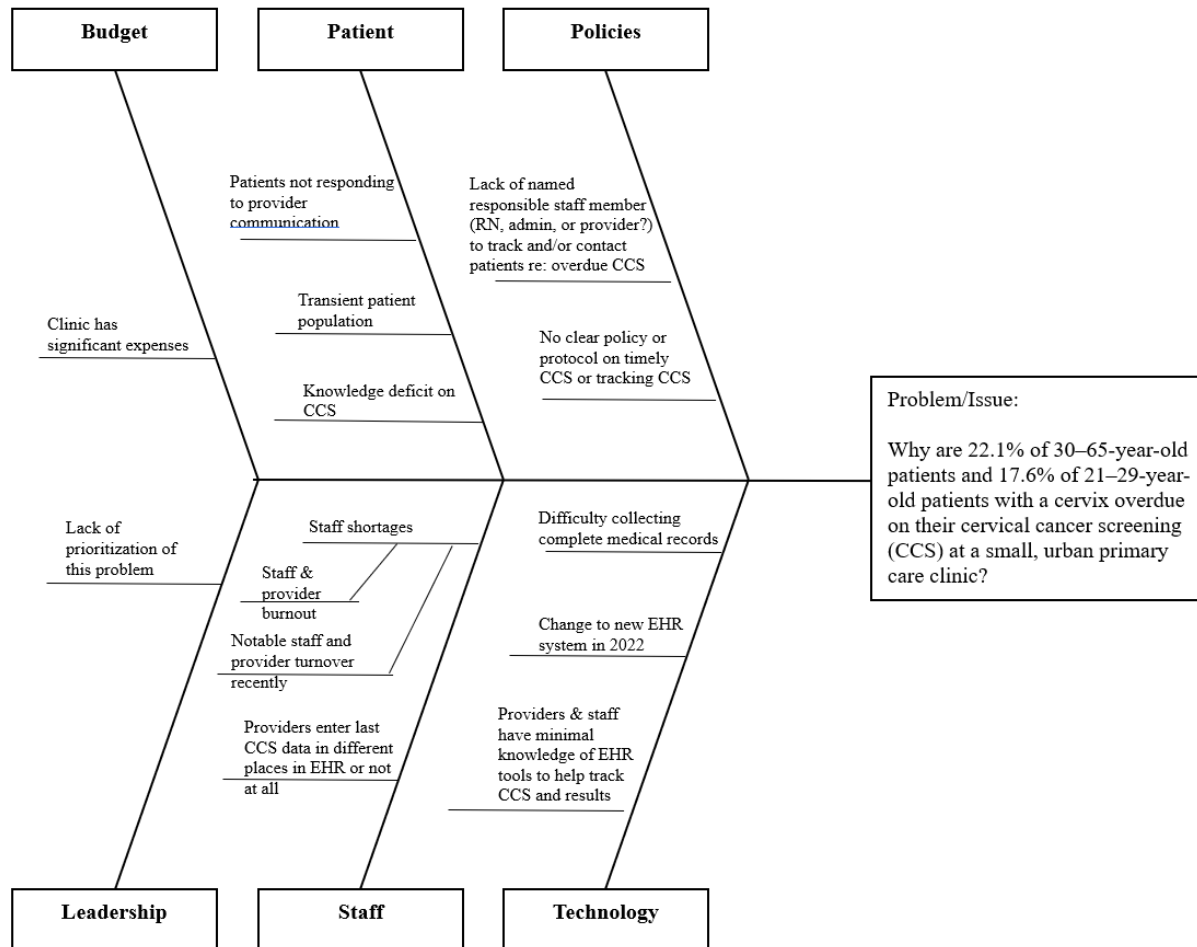
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Appendix A

Figure 1

Fishbone Diagram



Appendix B

Table 1

Evidence Review Tables

<p>Citation: Firmino-Machado, J., Varela, S., Mendes, R., Moreira, A., Lunet, N., Carmo, A., Cancela, A., Firmino, A., Ramos, A., Teixeira, A., Vieira, A., Badim, B., Tojal, C., Junqueira, C., Pinheiro, C., Peneda, E., Monte, H., Vieira, H. M., Proença, I., ...Santos, V. (2018). Stepwise strategy to improve cervical cancer screening adherence (SCAN-Cervical Cancer) – Automated text messages, phone calls and reminders: Population based randomized controlled trial. <i>Preventive Medicine</i>, 114, 123–133. https://doi.org/10.1016/j.ypmed.2018.06.004</p>					<p>Level: I, Quality A (JHNEBP)</p>
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results
<p>“to assess the effectiveness of a population-based intervention to invite women for cervical cancer screening, based on an automated and low-cost strategy... of invitation through automated and customized text messages, phone calls and reminders, in relation to the standard of care.” (p. 124)</p>	<p>Multi-center, parallel, population-based randomized controlled trial</p>	<p>Sampling technique: Convenience Eligible participants: women 25-49 years old, registered with one of two primary care clinic regions in Northern Portugal who send automated written invitations for cervical cancer (CC) screening, and eligible for CC screening Excluded: women without mobile phone number in national health database Accepted: 1220 women from 13 different primary care clinics; secretary from each clinic extracted eligible participants, primary researcher generated 1:1 randomization structure to be used by clinic secretaries to place participants in control or intervention groups; enrolled April to October 2017 Control: 615 women, 1 lost to inadequate implementation, 615 considered for analysis in December 2017</p>	<p>Control Protocol: received written letter in mail about 45 days prior to desired CC screening appt date, receiving same information as those in intervention group Intervention Protocol: assigned to either receive automated or customized (including use of motivational language, name, appt date & time, clinic location) text messages asking to confirm or reschedule appt, 2 attempts made on consecutive days, then automated phone calls to confirm or reschedule CC screening appt, 3 attempts made on consecutive days; SMS reminders of scheduled appt once confirmed 24-48 hours before appt time Treatment fidelity: participants, health providers, and research members not blinded; training for healthcare professionals on SMS messaging and phone call protocol; software to track if text messages received; no plan to follow up with women who did not successfully receive SMS; no protocol to update incorrect phone numbers</p>	<p>DV: number of women who were screened for CC on their scheduled date DV measurement method & time: computer software to track SMS message receipt and returned letters counted; analysis was done one day after scheduled appt.</p>	<p>Statistical Results: 488 (80.7%) of 605 women in intervention group successfully received text messages, of those, 378 also received phone calls with a statistically significant uptake of CC screening of 39.0% in the intervention group vs. 25.7% in the control (p=<0.001) – an increase of 13.3% (95% CI 8.5 to 18.5). There was no statistical significance between only receiving text message invitations for screening (25.3%) and receiving the standard practice, a written letter invitation (25.7%) (p=0.967) Conclusions: Researchers concluded that there was an increase of 13.3% in CC screening appt uptake between the intervention and control groups. Cost of intervention was about 0.10 euros per woman invited in the intervention group versus 0.80 euros in the control group.</p>

		<p>Intervention: 605 women, 9 lost to inadequate intervention implementation, 605 considered for analysis in Dec 2017</p> <p>Power analysis: 90% power was achieved, minimizing type II error; alpha set at 0.05. No effect size stated.</p> <p>Group Homogeneity: Table 1 shows baseline characteristics to be seemingly homogeneous, however authors note significant missing data in education and occupation categories; no p-value showing statistical homogeneity</p>			<p>Since cell phones are widely used among adults this could be an easily reproducible, relatively independent, low-cost intervention which could be implemented in varying healthcare settings.</p> <p>Clinical significance: Given the adequate power, alpha level, group homogeneity, randomization, and reasonable treatment fidelity helps to support the reliability, validity and generalizability of the study and a practice change can be considered if additional evidence supports these findings.</p>
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<p>Citation: Hirst, Y., Skrobanski, H., Kerrison, R., Kobayashi, L. C., Counsell, N., Djedovic, N., Ruwende, J., Stewart, M., & Von Wagner, C. (2017). Text-message reminders in colorectal cancer screening (TRICCS): A randomised controlled trial. <i>British Journal of Cancer</i>, 116(11), 1408–1414. https://doi.org/10.1038/bjc.2017.117</p>					<p>Level: I, Quality B (JHNEBP)</p>
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results
<p>“The primary aim of this RCT was to test the effectiveness of a text-message reminder to increase guaiac faecal occult blood testing (gFOBT) uptake...Our secondary aims were to examine whether or not a text-message reminder is more effective in improving uptake among first-time invitees than repeat invitees and to establish the efficacy of the text-messages by testing the effectiveness among the non-responders who also had a</p>	<p>Two-armed randomized controlled trial</p> <p>Study performed in London, United Kingdom</p>	<p>Sampling technique: convenience</p> <p>Eligible participants: patient in one of 6 “Clinical Commission Groups” in London, aged 60-74 years old, last gFOBT > 2 years ago, mobile number on file, consent to send pt text messaged signed and in EHR</p> <p>Excluded: not specifically stated</p> <p>Accepted: 8269 patients ages 60-74 y/o; Computer generated 1:1 randomization ratio to intervention or control group</p> <p>Control: 4135 patients, none lost to follow up</p>	<p>Control Protocol: “Usual care” - invitation letter to complete gFOBT sent to home of pt with gFOBT kit sent home one week later and reminder letter sent home 5 weeks later</p> <p>Intervention Protocol: Usual care as well as text message sent 7 weeks after initial invitation letter sent if gFOBT kit not yet completed and returned</p> <p>Treatment fidelity: multiple agencies involved in patient data pulls, possible incorrect or inactive mobile phone numbers on file, general practitioners (GP) all used same EHR tracking system iPlato; GPs not given formal training on their role in study</p>	<p>DV: portion of participants who returned gFOBT test kits</p> <p>DV measurement method & time: within 18 weeks of initial text message</p>	<p>Statistical Results: There was no statistically significant difference between the intervention and control groups. 40.5% of participants who received the text message intervention and 39.9% of those in the control group were screened for CRC (P=0.56). Statistical significance was shown in the CRC screening uptake of those who received the text message reminder for gFOBT completion for the first time (40.5%) vs. those who had received an invitation prior to this study (34.9%, P=0.02)</p> <p>Conclusions: While no statistical significance was demonstrated in the intervention group overall, text messaging reminders to increase</p>

<p>registered mobile number.” (p. 1409)</p>		<p>Intervention: 4134 patients, none lost to f/u Power analysis: no power analysis done. Risk of Type II error; significant P value set to ≤ 0.05; no effect size stated. Group Homogeneity: Limited baseline characteristics in Table 1 appear similar with P values calculated to show no statistical significance</p>			<p>uptake of CRC screenings in first time invitees was effective and demonstrated statistical significance. Clinical significance: Due to unknown power (risk Type II error), some limitations in treatment fidelity (affecting reliability and validity), further studies supporting the use of text messaging to increase uptake of CRC screening will help to validate these results. Group homogeneity, large sample size, and well detailed intervention and control group protocols, help to support the study results.</p>
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<p>Citation: Huf, S., Kerrison, R. S., King, D., Chadborn, T., Richmond, A., Cunningham, D., Friedman, E., Shukla, H., Tseng, F. M., Judah, G., Darzi, A., & Vlaev, I. (2020). Behavioral economics informed message content in text message reminders to improve cervical screening participation: Two pragmatic randomized controlled trials. <i>Preventive Medicine</i>, 139, 106170. https://doi.org/10.1016/j.ypmed.2020.106170</p>					<p>Level: I, Quality B (JHNEBP)</p>
<p>Purpose/Hypothesis</p>	<p>Design</p>	<p>Sample</p>	<p>Intervention</p>	<p>Outcomes</p>	<p>Results</p>
<p>“This study set out to assess the impact of SMS reminders and different SMS message content (informed by behavioral economics) on cervical screen (CS) participation.” (p. 2)</p>	<p>Two randomized controlled trials Mindspace Framework used</p>	<p>Sampling technique: Convenience Eligible participants: women 24-64 years old who were registered with a participating primary care clinic in Northwest London, and were eligible for a CS between Feb-Oct 2015; recruitment of providers included clinic consent to send SMS to eligible patients Excluded: patients undergoing medical treatment of any kind Accepted: Over the eight month study timeframe on a weekly basis, health phone operator team identified a total of 14,538 females from 40 primary care clinics divided into two studies by age: study 1 (age 24-29y/o) 3,133 females; study 2 (age 30-64y/o) 11,405 females;</p>	<p>Control Protocol: Invitation letter for CS at patient’s registered primary care office sent, no SMS sent Intervention Protocol: Invitation letter for CS at patient’s registered primary care office sent and three weeks later one SMS was sent. In <i>Study 1:</i> Primary care provider (PCP) endorsed SMS In <i>Study 2</i> participants received one of six SMS interventions: “an SMS with no manipulation, an SMS containing a message from their PCP, an SMS with a ‘total’ social norms message, an SMS with a ‘proportional’ social norms message, an SMS with a gain-framed message an SMS with a loss-framed message” (p. 2)</p>	<p>DV: CS participation at 18 weeks post intervention DV measurement method & time: No measurement tool or method explicitly stated; DV measured 18 weeks after written invitation letter sent to participants</p>	<p>Statistical Results: <i>Study 1:</i> there was a significant difference in the uptake of CS between the control (26.4%) and intervention (40.9%) groups (OR 1.9, 95% CI, 1.53-2.35, $p < 0.001$) <i>Study 2:</i> A significant difference was found between the control (34.1%) and the six intervention groups (39.9 to 47.4%; OR 1.29 to 1.75 95% CI; all $p < 0.05$) Conclusions: The researchers concluded that a text message reminder, after written invitation can significantly increase uptake of CS among women living in an urban environment, with SMS from their PCP showing the most significant increases in CS participation and women 21-29 years old being 1.5 to 2.3 times more likely to receive CS.</p>

		<p>Pseudorandom number generator for randomization into 1:1 ratio for Study 1 and 1:1:1:1:1:1 ratio for Study 2. Control: <i>Study 1:</i> 1,453 females, 65 lost to follow up; <i>Study 2:</i> 1,568 females, 300 lost to follow up Intervention: <i>Study 1:</i> 1,482 females, 971 lost to follow up; <i>Study 2:</i> 9,084 females, 6,578 lost to follow up Power analysis: Power analysis not done; no effect size stated; Alpha 0.05; sample sizes calculated based on prior year uptake of CS for control and 5% increase to intervention; increased risk of type II error Group Homogeneity: Baseline characteristics in Table 1 appear homogeneous, however included only age and poverty level (IMD decile). No p value stated.</p>	<p>Treatment fidelity: participants and researchers not blinded; exclusion criteria determined by individual providers – no uniformity; All text messages sent 3 weeks after invitation letter; All text messages sent at same date/time using iPlato patient messaging; content of text messages not validated; limited known baseline characteristics; significant level of participants without updated or any mobile phone number on record</p>		<p>Clinical significance: While the results are promising, without power analysis and with significant loss of participants to follow up and treatment fidelity and baseline characteristic limitations, there are significant threats to the reliability and validity of this study. Additionally, with limited baseline characteristics given, generalizability is affected. However, findings are in line with prior research. Future studies addressing these issues may help to support these findings.</p>
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<p>Citation: Muller, C., Robinson, R., Smith, J., Jernigan, M., Hiratsuka, V. Y., Dillard, D. A., & Buchwald, D. (2017). Text message reminders increased colorectal cancer screening in a randomized trial with Alaska Native and American Indian people. <i>Cancer</i>, 123(8), 1382–1389. https://doi.org/10.1002/cncr.30499</p>					<p>Level: I, Quality B (JHNEBP)</p>
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results
<p>The purpose was “to design a text messaging intervention to increase colorectal cancer (CRC) screening among AN/AIs ages 40–75 years old in the Southcentral Foundation (SCF) healthcare system in Anchorage, Alaska.” (p. 1383)</p>	<p>Two-armed randomized controlled trial</p>	<p>Sampling technique: convenience Eligible participants: “1) AN or AI heritage documented in the electronic health record; 2) empanelment to a clinic primary care provider; 3) enrollment in the clinic electronic health messaging program; 4) possession of a text-enabled mobile phone; 5)</p>	<p>Control Protocol: Patients were given “usual care” to include phone and mail reminders for CRC screening and/or physician referral at clinic appts. Intervention Protocol: Eligible patients provided “usual care” in addition to culturally/ethnically tailored reminder text messages sent to encourage CRC screening. Reminder messages resent at 1</p>	<p>DV: uptake of CRC screenings; rate of responses to text messages DV measurement method & time: No measurement tool or method explicitly stated; DV measured at 3 and 6 months after last text message sent</p>	<p>Statistical Results: For those 50-75 y/o, the text message intervention group showed an increase of 42% (P=0.7) in CRC screening rate as compared to the control group. For those 40-49 y/o, there was a 24% (P=0.12) increase over the control group. Conclusions: Including text messaging reminders could be an effective, low barrier way to increase CRC screenings.</p>

		<p>signing the optional consent to participate in research on the effectiveness of electronic health messaging for health promotion; 6) no history of CRC or colectomy; 7) current eligibility for CRC screening; and 8) aged 40 years or older” (p. 1384); Randomization 1:1 ratio to intervention and control groups Excluded: not specifically stated Accepted: 808 in 1st wave (50-75y/o); 1,578 in 2nd wave (40-75y/o) Control: 1,193 participants Intervention: 1,193 participants Power analysis: no power analysis done. Risk of Type II error; significant P value set to ≤ 0.05; no effect size stated. Group Homogeneity: baseline characteristics limited, however appear similar. No statistical significance calculated</p>	<p>and 2 months if no response. If pt responded, referral or FIT test sent to patient. Treatment fidelity: All patients informed and signed written consent to receive text by phone and to be a part of a research study; participants blinded to research study group assignments, research staff collecting data were blinded to participant group assignments; researchers did not have access to individual level data; possible sharing of mobile phones by participants with non-participants</p>		<p>Clinical significance: While the results are promising, without statistical significance, power analysis and with limitations in treatment fidelity and baseline characteristics, there are significant threats to the reliability and validity of this study. Additionally, with limited baseline characteristics, intervention performed in a specific population and possibility of “contamination” of text messages due to patients sharing mobile phones with others, generalizability is affected. This said, findings are in line with prior research. Future studies addressing these issues may help to support these findings.</p>
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<p>Citation: Mehta, S. J., Oyalowo, A., Reitz, C., Dean, O., McAuliffe, T. L., Asch, D. A., & Doubeni, C. A. (2020). Text messaging and lottery incentive to improve colorectal cancer screening outreach at a community health center: A randomized controlled trial. <i>Preventive Medicine Reports</i>, 19, 101114. https://doi.org/10.1016/j.pmedr.2020.101114</p>					<p>Level: I Quality A (JHNEBP)</p>
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results
<p>The purpose was to “evaluate the impact of adding a lottery-based financial incentive to a bidirectional text messaging program that asks patients to opt-in to receive mailed FIT at a community health center.” (p. 2)</p>	<p>Two-arm pragmatic randomized controlled trial</p>	<p>Sampling technique: Convenience Eligible participants: Pts “between ages 50–74 years who had a mobile phone enabled to send and receive text messaging, active health insurance, at least one visit to the clinic in the past 12 months, and were due for CRC screening. Screening eligibility</p>	<p>Control Protocol: no control group Intervention Protocol: <i>Text message only arm:</i> eligible pts sent text messages with CRC screening education and invitation to participate in screening. Pt could respond “yes” and FIT test would be</p>	<p>DV: percentage uptake of mailed FIT test within three months of first sent text message; percent of participants opting into CRC screening via text message DV measurement method & time: EHR – review of medical records via research staff from April to July 2017, with 3 month follow up on all participants</p>	<p>Statistical Results: 34.3% (P= 0.42) in text message arm and 29.8% (P> 0.99) in text and lottery arm responded to SMS requesting a FIT test and it was mailed; at 3-month evaluation, 12.1% each in both arms completed the FIT test; 6% (n=2) of</p>

		<p>was defined as not having had a colonoscopy in the past 10 years, flexible sigmoidoscopy in the last 5 years, or stool testing in the past 12 months.” (p 2)</p> <p>Excluded: “a personal history of CRC or other gastrointestinal cancer, inflammatory bowel disease, colon polyps, colectomy, Lynch Syndrome, familial adenomatous polyposis syndrome, iron-deficiency anemia, a recent history of lower gastrointestinal bleeding, or a first degree relative with colorectal cancer...diagnosis of metastatic cancer, end stage renal disease, congestive heart failure, dementia, or liver cirrhosis” (p. 2); computerized random generator randomized participants at a 1:1 ratio into each arm of the study</p> <p>Accepted: 281 patients</p> <p>Control: no control</p> <p>Intervention: <i>Text message only arm:</i> 140 patients; <i>Text message and lottery arm:</i> 141 patients</p> <p>Power analysis: Power analysis done, but not met. Needed 320 participants and only had 281. Risk of Type II error; significant P value set to ≤ 0.05; no effect size stated.</p> <p>Group Homogeneity: Baseline characteristics in Table 1 homogeneous as evidenced by P values all greater than 0.05; however 63% of participants were female and 89% of participants were black.</p>	<p>sent with completion and return instructions;</p> <p><i>Text message and lottery arm:</i> eligible pts received same text message plus additional text including 1 in 5 chance to win \$100 if FIT test completed and returned; for both arms – if no response after initial text message, reminder message sent 3 business days later, and a last reminder message sent three days after that.</p> <p>Treatment fidelity: researchers blinded to randomization and patient data; chart review after initial data pull for eligible pts by research staff to ensure inclusion criteria met; participants in each group received text messages with the same verbiage; message verbiage regarding CRC screening and invitation same for both groups;</p>		<p>those who completed the FIT test had a positive result and needed further testing.</p> <p>Conclusions: The researchers concluded that the use of text messaging to increase CRC screening uptake can be a cost effective, low barrier modality in populations with low socioeconomic status.</p> <p>Clinical significance: The lack of a control group, lack of statistical significance, and small sample size affects validity and reliability; no baseline characteristics given it is difficult to generalize these findings and may introduce confounding factors into results. Additionally, not meeting power, thus a type II error cannot be ruled out. Patient population predominantly black, female, and low socioeconomic status may affect generalizability. However, findings were in line with previous evidence, the treatment fidelity was well adhered to, and there was a detailed intervention protocol.</p>
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<p>Citation: Nanda, A. D., Reifel, K. R., Mann, M. P., Lyman-Hager, M. M., Overman, K., Cheng, A. L., Moormeier, J., & Ahmadiyah, N. (2022). Text-Based Intervention Increases Mammography Uptake at an Urban Safety-Net Hospital. <i>Annals of Surgical Oncology</i>, 29(10), 6199–6205. https://doi.org/10.1245/s10434-022-12130-x</p>					<p>Level: I Quality B (JHNEBP)</p>
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results
<p>“To determine whether a text-based reminder and opportunity for scheduling [mammography] was successful in this cohort [low-income women], and whether open-ended scheduling or discrete-option scheduling was more effective.” (p. 6200)</p>	<p>Randomized controlled trial</p>	<p>Sampling technique: Convenience Eligible participants: 50–65-year-old women established (seen in last three years) at one of five primary care offices of a hospital in Kansas City, Missouri, with no mammography screening in last two years; 2,129 patients identified through EHR chart audit Excluded: older than 65 years Accepted: 1,277 female patients – of patients extracted from EHR audit, 20% chosen for each the control and two intervention arms; randomization using random-number generator Control: 434 female patients Intervention: <i>Arm 1:</i> 423 female patients; <i>Arm 2:</i> 420 female patients Power analysis: no power analysis done. Risk of Type II error; significant P value set to ≤ 0.05; no effect size stated. Group Homogeneity: No baseline characteristics given outside of eligible criteria (age 50-65y/o)</p>	<p>Control Protocol: usual care (no definition provided) Intervention Protocol: two intervention arms sending up to three text message requests to schedule mammogram screening appointment before discontinuing messaging; first text send by research assistant; Arm 1 sent limited appt time options, Arm 2 sent many appt time options; participants could reply to text or call clinic to schedule; scheduling confirmation done by nurse navigator and radiology tech. Treatment fidelity: pilot study done prior to RCT to assess efficacy of content of text messages sent; providers and staff blinded to study; researchers and participants unblinded; text messaging system linked to EHR which staff already uses; multiple different people involved in sending intervention texts and confirming appts</p>	<p>DV: uptake of mammography within three months of intervention DV measurement method & time: Direct EHR review for each participant by researchers at three months post intervention</p>	<p>Statistical Results: A significant difference was reported in the uptake of mammography screening between intervention group (10.2%) vs control group (6.2%) at three months post-intervention ($p=0.03$). Within the intervention groups, 14.8% initially responded to SMS, 10.3% scheduled a screening through text message, and 63.2% of those who scheduled completed their mammogram; no difference found between study arms Conclusions: The researchers concluded that the use of two-way text messaging significantly increases uptake of mammography. Additionally, researchers found fewer appt time option SMS just as effective as multiple appt time option texts. Clinical significance: With no baseline characteristics given it is difficult to generalize these findings and may introduce confounding factors into results. Additionally, no power analysis was given, thus a type II error cannot be ruled out. However, treatment fidelity was well adhered to and a detailed intervention protocol, and findings were in line with previous evidence.</p>

<p>Citation: Uy, C., Lopez, J., Trinh-Shevrin, C., Kwon, S. C., Sherman, S. E., & Liang, P. S. (2017). Text Messaging Interventions on Cancer Screening Rates: A Systematic Review. <i>Journal of Medical Internet Research</i>, 19(8), e296. https://doi.org/10.2196/jmir.7893</p>					<p>Level: II, quality B (JHNEBP)</p>
Purpose/Hypothesis	Design	Sample	Intervention	Outcomes	Results
<p>“To assess the effect of text messaging interventions on increasing patient adherence to screening recommendations for breast, cervical, colorectal, and lung cancers.”</p>	<p>Systematic review</p>	<p>Search Strategy: Extensive search for studies published between January 2000 to January 2017 in EMBASE, PubMed, Clinicaltrials.gov, Cochrane Library, HSRProj, Inspec, NIH Reporter, BIOSIS Citation Index, Proquest Dissertations & Theses Global as well as performing a manual search. 2,238 studies were initially identified, duplicates removed (18). Two independent investigators reviewed the articles with differences settled by agreement or by third investigator when needed. If missing data or further clarification needed, the articles’ authors were contacted.</p> <p>Eligible Studies: Clinical trials studying how text messaging affects screenings for breast (mammography), cervical (Pap smear & HPV testing), colorectal (sigmoidoscopy & FOBT), and lung cancers (low-dose CT); all languages included</p> <p>Excluded: Text message intervention could not be isolated, results not available, lack of control group, duplicate data from larger study already included; primary outcome not uptake of screening.</p> <p>Included: Nine studies were included in the SR, seven RCTs and two nonrandomized trials, five studying breast cancer screening, one studying cervical cancer screening, and three covering colorectal cancer screening, conducted in five countries totaling 77,099 participants, mainly female, ages 20-75.</p> <p>PRISMA: PRISMA diagram provided indicating initial identification; exclusion details given</p> <p>Power analysis: Not applicable to SR</p>	<p>Control: Patients eligible for cancer screening receiving usual care</p> <p>Intervention: Patients eligible for cancer screening receiving text messages to encourage uptake of cancer screening</p> <p>Protocol: No applicable to SR</p>	<p>DV: Rates of uptake of cervical, breast, or colorectal cancer screenings</p> <p>Measure: Absolute or relative rates of cervical, breast, or colorectal cancer screenings</p>	<p>Level of Measurement: Researchers used the chi-square test to evaluate absolute screening rates between the control and intervention groups.</p> <p>Outcome Data Retrieval: Data assessed from nine trials – no meta-analysis done due to number of studies evaluated and substantial design differences between studies</p> <p>Analysis: Researchers found a 4.5% to 15% increase in uptake of cancer screening across breast and cervical screening studies, with relative screening rate increases of 20% to 63%.</p> <p>Conclusions: Patients receiving text message interventions for cervical and breast cancer screenings demonstrated an increase in uptake of cancer screening and may be an efficient, low-cost, and effective way to improve cancer screenings in eligible patients. Since most studies in SR from other countries, applicability to the US health population may be limited. Further studies carried out in US may be warranted.</p> <p>SR Bias Risk: Cochrane risk of bias tool used to assess bias risk.</p>

Note: Evidence & Quality Rating: Johns Hopkins Nursing Evidence-Based Practice Quality Grade (JHNEBP) (Dang & Dearholt, 2018)

Appendix C

Table 2

Evidence Synthesis

Project Title: Increasing Uptake of Cervical Cancer Screening Through SMS Text Messaging			
JHNEBP Model Level	Total Number of Sources	Author and Quality Rating of each study	Synthesis of Findings
<p>Level 1 Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis</p>	6	Firmino-Machado et al., 2018, A Hirst et al., 2017, B Huf et al., 2020, B Mehta et al., 2020, A Muller et al., 2017, B Nanda et al., 2022, B	<p>All six RCTs included in this synthesis evaluated the effectiveness of text messaging to increase uptake of preventative health screenings. Specifically, two studies specifically discussed CCS, three looked at CRC, and one at mammography. The outcomes measured were all focused on the rate of uptake of the above stated preventative health screenings. Overall, baseline demographics were limited mainly to age, gender and race. One study included income level and insurance status. This could negatively affect generalizability, however, five of the six had moderate to large sample sizes all studies were performed in US or Europe in large cities, increasing generalizability to high-income-country health systems in urban environments.</p> <p>Intervention protocols were similar in all six studies using text message reminder messages sent to participants with a mobile phone number on file, with three of the six having an option to reply to the text message to schedule a screening appointment. These similarities strengthen internal validity. Power was achieved in one of the six studies, weakening the internal and external validity of the body of evidence. Three of the six studies showed statistically significant increases in the outcome evaluated uptake of preventative cancer screenings from sent text message reminders, adding validity and strength to the body of evidence.</p>

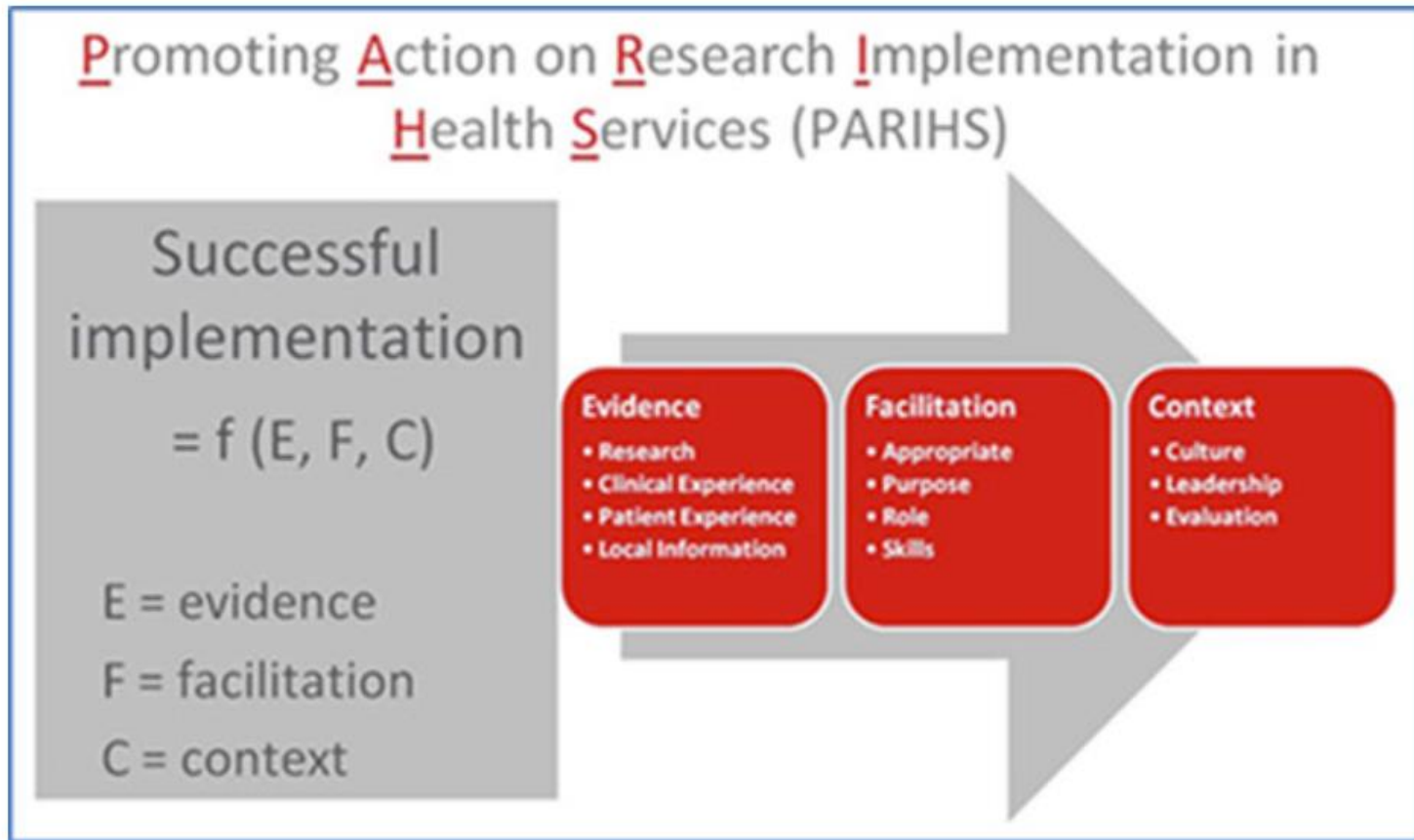
<p>Level II Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis</p>	<p>1</p>	<p>Uy et al., 2017, B</p>	<p>In this systematic review of a combination of RCTs and quasi-experimental studies, Uy et al (2017) found that adherence to preventative cancer screening was increased with the use of text message reminders to patients. The search strategy and selection of studies was extensive, thorough and well planned by the authors, with two independent investigators reviewing articles where differences of decision occurred. A PRIMSA was included and analysis of the finds was included. Since most studies in this study were from other countries, applicability to the US health population may be limited.</p>
<p>Level III Non-experimental study · Systematic review (SR) of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or SR of qualitative studies with or without meta-synthesis</p>			
<p>Level IV Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence</p>			
<p>Level V Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence</p>			
<p>Overall Quality Rating w/rational and Recommendation: I B, Good and consistent evidence – practice change. The evidence from this body of research suggests the use of text message reminders to patients as a tool to increase the uptake of preventative healthcare, including cervical cancer screenings, is effective. While individually the clinical significance of the results is small, taken as a whole, the evidence is strengthened. Additionally, the intervention is low-cost, low risk, and once implemented, minimal is needed to maintain the intervention. Because the majority of the patient population at this clinical site own mobile phones, this could prove to be an effective tool to increase uptake of CCS.</p>			
<p>Recommendations Based on Evidence Synthesis</p> <ul style="list-style-type: none"> • Strong, compelling evidence, consistent results: solid indication for a practice change. • Good and consistent evidence – practice change • Good but conflicting evidence: questionable indication for practice change; consider risk/benefit analysis • Little or no evidence: no indication for practice change 			

Note: Evidence & Quality Rating: Johns Hopkins Nursing Evidence-Based Practice Quality Grade (JHNEBP) (Dang & Dearholt, 2018)

Appendix D

Figure 2

Promoting Action on Research Implementation in Health Services Framework



Appendix E

Figure 3

Process Map of Current Workflow for CCS Tracking and Uptake

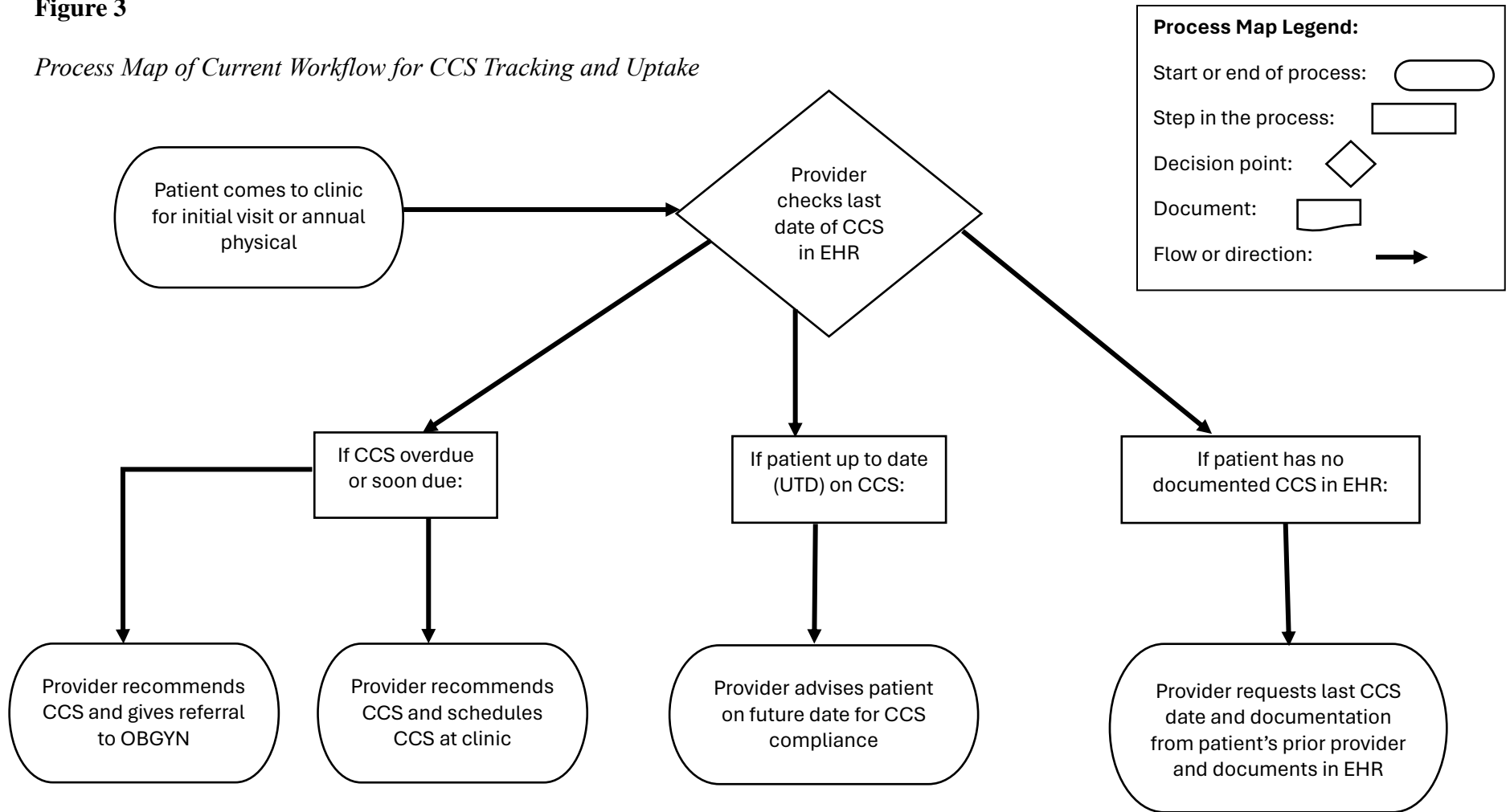
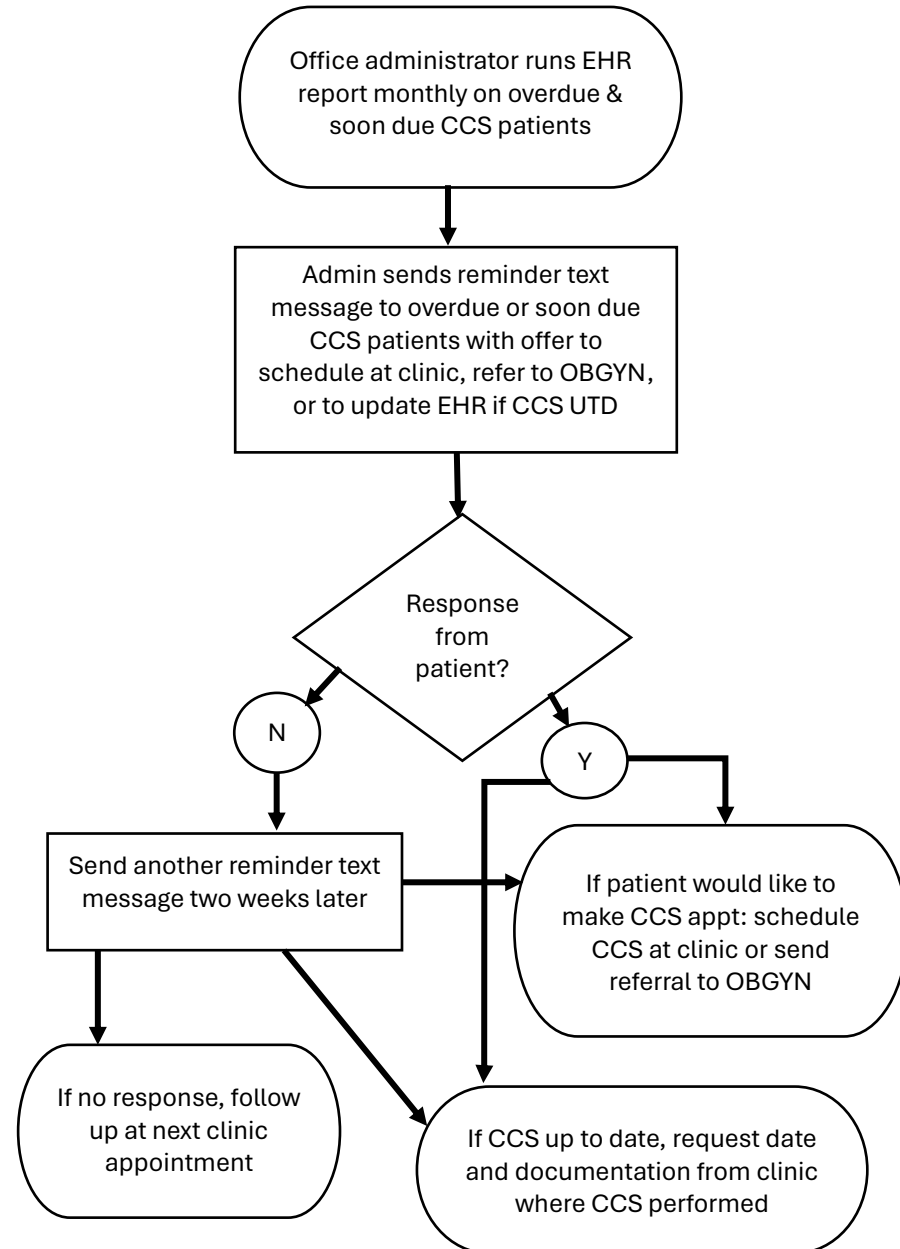
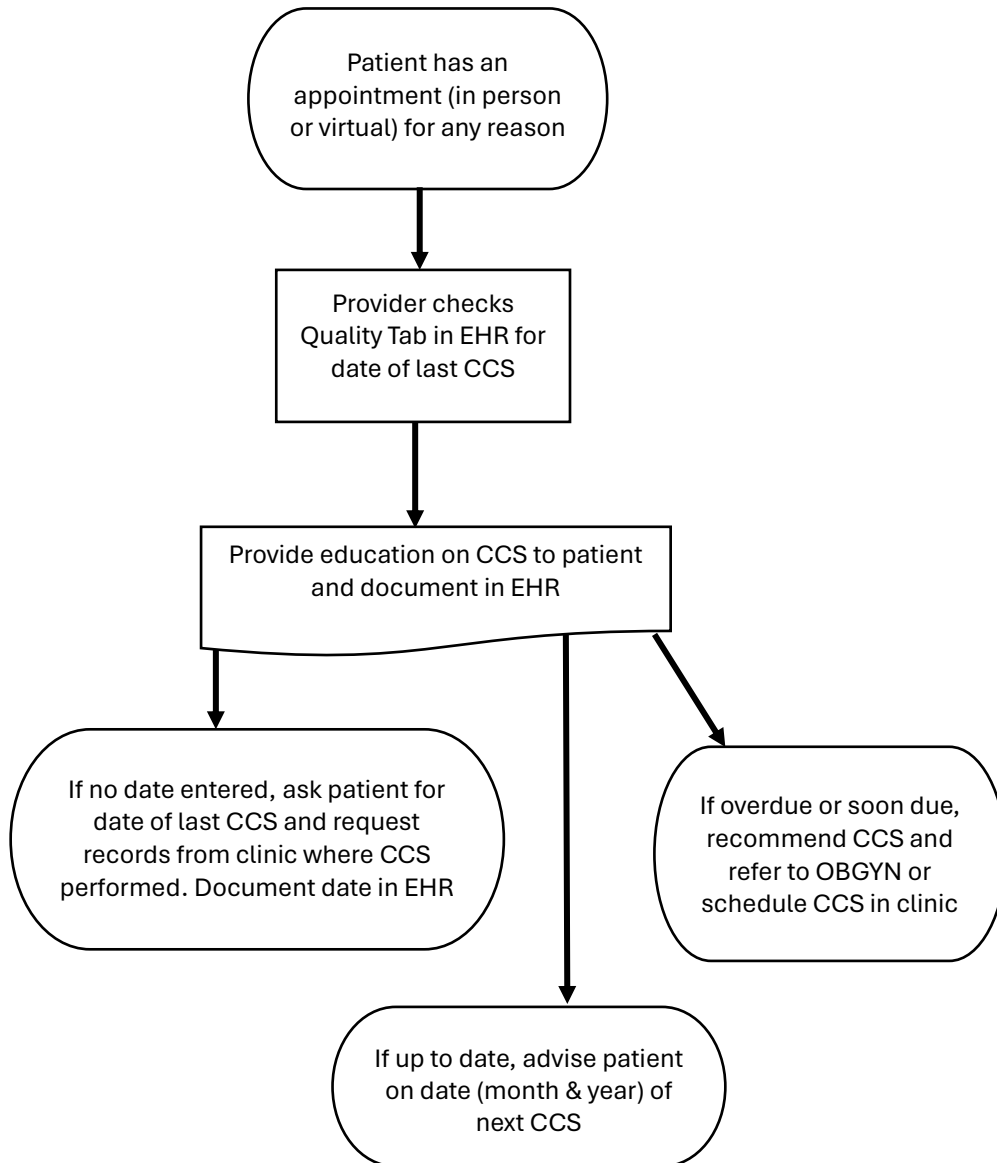


Figure 4

Process Maps of Desired Workflow for CCS Tracking & Uptake



Appendix F

REDCap Audit Tool

Increasing Uptake of Cervical Cancer Screening Through SMS Text Messaging
 Page 1

Cervical Cancer Screening Tracking Form

Record ID _____

Patient ID number _____

Patient Age 21-29 years old
 30-65 years old

Date of last cervical cancer screening _____

Was CCS overdue or soon due (within 3 months)? Overdue
 Soon due (within 3 months)
 No "last CCS" date entered into EHR
 (Per USPSTF guidelines)

Date initial reminder text message was sent _____

Patient response to initial reminder text message Responded
 No response
 Opted out
 CCS up to date via another provider

Date of follow up text message _____

Patient response to follow up text message reminder? Responded
 No response
 Opted out
 CCS UTD via another provider

Was documentation of current CCS provided to clinic? Yes
 No

Date scheduled for CCS at clinic _____

Was GYN referral for CCS ordered for patient? Yes
 No

Date GYN referral CCS appt scheduled for _____

Was CCS completed during implementation phase? Yes
 No
 Scheduled but not yet completed
 Unknown
 (CCS can be completed in clinic or reported by patient or outside GYN office)

Appendix G

Figure 1

Rates of Text Messages Sent and Responses

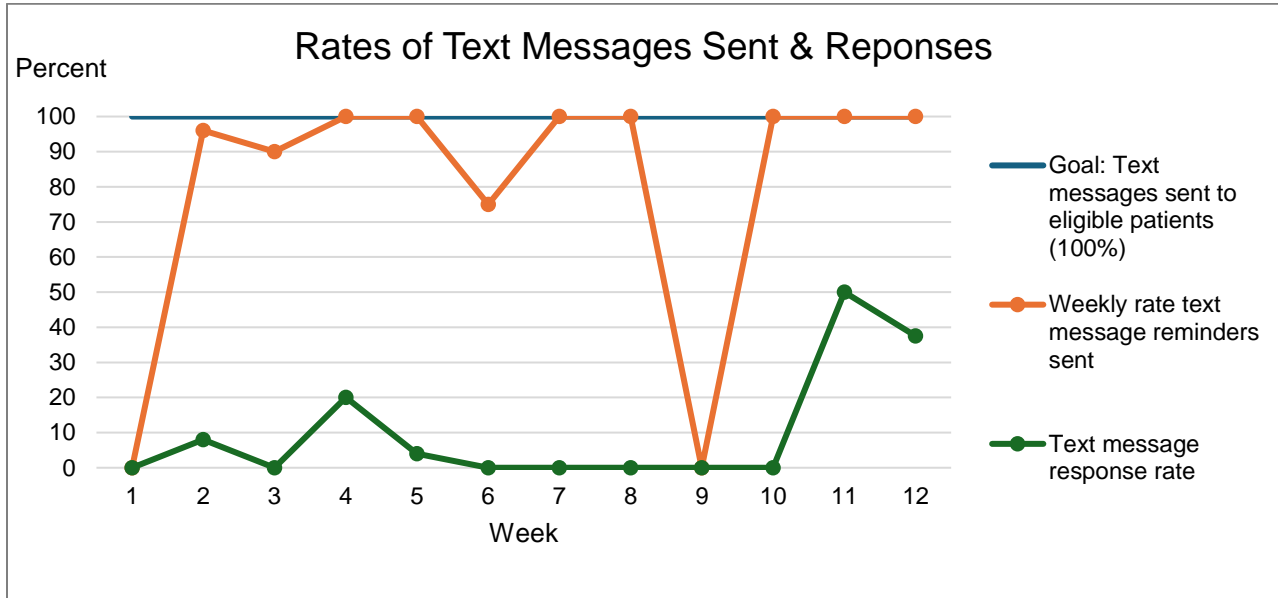


Figure 2

How Patients Responded to Text Message

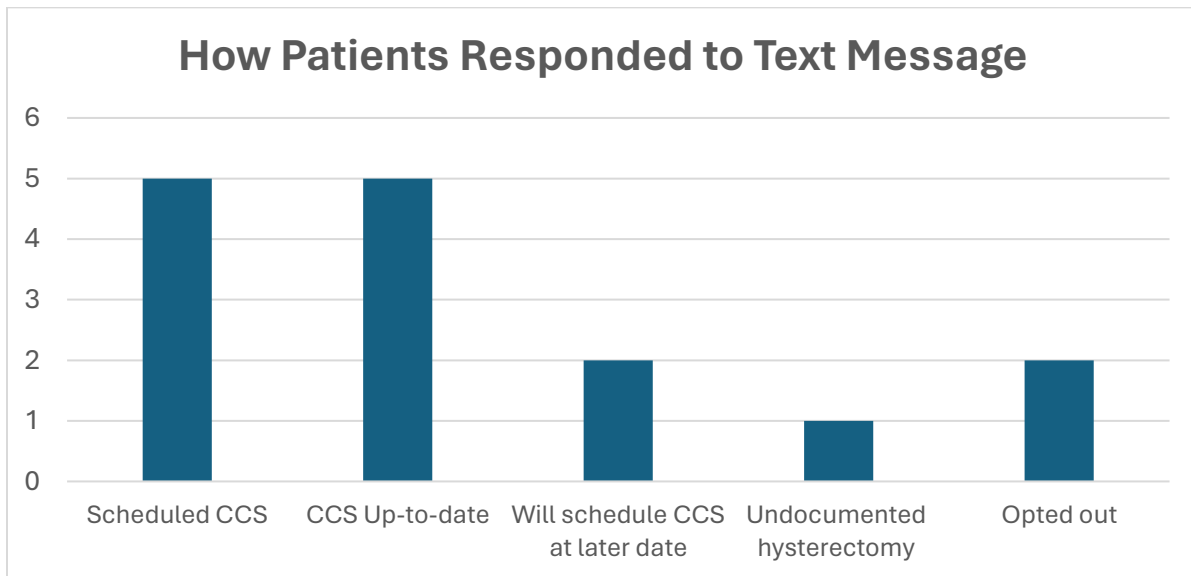


Figure 3

Pre- and Post-intervention CCS Compliance Rate

