Text Message Reminder to Improve Annual Mammogram Screening Participation

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Abstract

Problem: American Cancer Society recommends annual mammogram screening for women between 45 to 54 years. At a small, independent, primary care clinic, between June 1, 2022, and August 31, 2022, 11% (n=4) of the patients ages 45 to 54 years (n=35) who attended annual exams completed their recommended annual mammogram. **Purpose**: This Quality Improvement (QI) project implemented a cost-effective text message reminder system and health promotion education on breast cancer screening over 15 weeks in the fall of 2022. The initiative aimed to improve mammogram screening participation among women between 45 to 54 years at the clinic by more than 50%. **Methods**: Using a validated educational pamphlet, providers educated women 45 to 54 years who attended their annual physical and were overdue for their annual mammogram screening. Patients received Google Voice text message reminders one week after their annual physical visit. A second follow-up reminder was sent in two weeks, and a third one in the next two weeks if the patient still did not have a scheduled mammogram. **Results**: Twenty-eight patients met eligibility criteria, of which 93% (n=26) received text message reminders. Of the 26 patients who received text message reminders, 38% (n=10) responded, indicating they had scheduled their mammogram, and 27% (n=7) completed their mammogram, following a total of 61 text message reminders. **Conclusions**: When compared to the baseline annual mammogram participation rate of 11% to the QI project participation rate of 27%, there was an increase of 145% in the annual mammogram participation rate. Of the patients who scheduled their mammogram (n=10), 70% completed their mammogram during the 15 weeks (n=7). Text message reminder is a simple, cost-effective, and sustainable method to improve annual mammogram screening participation in primary care.

Text Message Reminder to Improve Annual Mammogram Screening Participation

In the United States, breast cancer is the second most common cancer among women and is the fourth leading cause of cancer-related deaths (CDC, 2021). The American Cancer Society (ACS) recommends yearly mammograms for a female between 45 to 54 years since early breast cancer diagnosis with mammography has been shown to increase survival among breast cancer patients (2021). However, at a small, independent, primary care clinic, between June 1, 2022, and August 31, 2022, 11% (n=4) of the patients ages 45 to 54 years (n=35) who attended annual exams completed their recommended annual mammogram which is less than 41 % of women who attended annual mammography in the County (County Health Rankings, 2021). Lack of cost-effective mammogram screening reminders, education on breast cancer screening, and health disparities were seen as the root causes of the lack of participation in the annual mammogram screening at the clinic. Hence, a Quality Improvement (QI) project was implemented to improve annual mammogram participation at the clinic by more than 50% among women 45-54 years overdue for their annual mammogram. Practice change was obtained by providing standardized breast cancer screening educational pamphlets to eligible participants during the clinic visit and by implementing a cost-effective text message reminder system that reminded the patients to schedule their mammograms after their clinic visit, as seen in **Appendix A.**

Available Knowledge

In Orr & King's (2015) meta-analysis of randomized control trials (RCT), SMS message reminder was found to be a simple and cost-efficient method for healthy behavior changes across age groups and backgrounds ($p<0.001$). For the statistical analysis of the study, a significance level of 0.05 was utilized. In Buttenheim et al. (2022), text message reminders, compared to no reminders, positively affected behavior change, as evidenced by increased influenza vaccine

uptake (p=.004). In the same study, participants who also texted back "Yes," indicating their intention to get immunized, had a higher likelihood of getting immunized (78.56%) than those who did not (15.68%) (P<0.001). In Buttenheim et al. (2022), the level of significance used for statistical analysis was 0.05.

A systematic review of 8 RCTs also shows that when compared to the verbal reminder, SMS reminder increases healthcare appointment attendance (RR 1.14; 95% CI 1.03 to 1.26) (Gurol-Urganci et al., 2013). In the RCT study by Kerrison et al. (2015), sending women a text message reminder before their first routine breast screening appointment significantly increased attendance and increased the likelihood of attendance by 28 percent among women from the most deprived areas. In addition, breast screening uptake was higher (64.4%) in the text-message reminder group when compared to the standard invitation group (59.1%) in the intention-to-treat analysis (P=0.01). The level of significance used for the statistical analysis of the study was 0.05.

Studies show that SMS reminder overall is effective in increasing mammogram screening participation rate than with no interventions or when compared to standard practices such as verbal reminders. In addition, SMS reminder is equally effective in improving mammogram screening rates in hard-to-reach communities.

Rationale

The theoretical framework of the Health Belief Model (HBM), which explains the interventions for the QI project, was developed in the 1950s by social psychologists to understand how to increase participation in Tuberculosis screening programs (Butts & Rich, 2018). Based on HBM constructs, women will more likely attend mammography if they feel susceptible to breast cancer, understand the severity of the disease, perceive that the benefits of screening are more significant than the barriers, and receive either internal or external cues to action (Butts & Rich,

2018). Therefore, providing education on breast cancer screening and providing patients with an educational pamphlet on the risks and prevention of breast cancer will help the patients acknowledge greater perceived benefits of breast cancer screening and improve self-efficacy to attend mammogram screening (**See Figure 1**). HBM has been used in addressing preventative health behavior in various studies such as social media and health behavior change (Laranjo, 2016), sexual health and teenagers (Mckellar & Sillence, 2020), influenza vaccination (Conner & Norman, 2015), and breast cancer screening (Kirag & Kizilkaya, 2019). In addition, text message reminders are utilized to provide an external cue to the patients as an external motivational factor.

Methods

Context

At the small local independent clinic, ordering a mammogram involved providing a paper referral to the patients with a list of radiology clinics for patients to make appointments. Once patients left the clinic with a mammogram referral, they were not followed up, and no reminders were sent to the patients regarding their mammogram scheduling. The only way clinicians could determine if patients completed their mammogram was through the uploaded mammography results (**See Appendix B**). Technology, finance, and staffing were major barriers to not having a mammogram scheduling reminder system. The existing electronic health record (EHR) was supplied and maintained by an outside vendor. Lack of in-house Information Technology (IT) support posed a challenge to modifying EHR based on clinic needs, such as text messaging. In addition, the existing EHR system could not integrate electronic mammogram orders with mammogram schedules. Once the patient completed their mammogram and the results were uploaded electronically to the EHR, the mammogram screening status of the patients was updated from "due" to "done." The clinic required a consistent, cost-effective reminder system to encourage

patients to complete their mammograms by the annual recommended date. The QI project team includes the administrative sponsor, who is the chief medical provider at the clinic, the clinical site representative (CSR), designated staff as the project champion (QIPC), the DNP student as the project leader (QIPL), and the faculty advisor.

Intervention

A paid Google Voice service, easily accessible to the QIPC's clinic desktop, was used for sending text message reminders. Google Voice was utilized successfully as an inexpensive online text messaging system to decrease no-show rates significantly (Anthony et al., 2019). Buy-in from the stakeholders was achieved by leveraging the benefits and the cost-effectiveness of Google Voice service and discussions on how the process change enables patients' self-care by getting mammograms. With the information obtained from CDC guidelines on how to write short text messages effectively, the Project Champion, in coordination with the CSR and the sponsor, created the text message (CDC, 2019). Accountability was ensured by ensuring team members understood their roles and responsibilities, providing clinical supervision, and conducting weekly data analysis.

The current EHR did not have an integrated search functionality to obtain relevant data for the QI project. As a result, the Project Champion had to individually go through each patient chart to ensure that the patients met the criteria for the text message reminders. The Project Leader, therefore, worked with the IT division, which assisted in streamlining the search function to include mobile phone numbers, MRN numbers, age, gender, clinic visit date, mammography-due date, and mammogram-done date. In addition, the QIPL collaborated with the sponsor and designated half an hour on Thursdays for the QI project champion to work on project-related tasks. The QI project leader also communicated with the sponsor regarding all the costs involved and

ensured the project champion would receive a letter of appreciation for her contribution to the QI project. The strategy effectively motivated the QIPC to carry out her role.

PowerPoint handouts on the risk factors and the importance of breast cancer screening as well as current guidelines based on ACS, project goals, and strategies, were provided during the staff education. In addition, a cheat sheet designed to act as a quick reminder tool was provided to the providers. The education pamphlets were printed on color paper for visual effect and kept in each patient's room for distribution for easy access. The QIPL also posted CDC breast cancer awareness posters in each patient's room. The QIPL collected the last three months of baseline data and received feedback on the text message content from the sponsor, CSR, and the QI project champion before sending a reminder. Using a standardized educational pamphlet (**See Figure 2**), providers educated women 45 to 54 who attended their annual physical and were overdue for their annual mammogram screening. Following education, each patient received Google Voice text message reminders one week after their annual physical visit. A second follow-up reminder was sent in two weeks, and a third one in the next two weeks if the patient still did not have a scheduled mammogram (**See Appendix A, Table 1 & Figure 3**). The frequency of text message reminders is based on studies where text messages have been effectively sent weekly and biweekly to promote healthy behavior (Fischer et al., 2026; Gipson et al., 2018). QIPL analyzed Google Voice text message history and the data from the EHR for discrepancies and recorded weekly data in REDCap, a HIPAA-compliant, password-protected server only accessible to QIPL. QIPL also received weekly feedback from the sponsor, staff, and providers to monitor the project's progress.

Measures

The structure data was measured based on the successful implementation of a cost-effective Google Voice text message reminder system, the creation of an EHR data search, and the

availability of validated educational pamphlets. QIPC also demonstrated the knowledge, functionality, and use of the Google Voice text message reminder system after being trained on the use of the system by the Project Leader. In addition, the providers successfully provided educational pamphlets to the eligible patients during their annual visit. The monthly cost of Google Voice with unlimited text message service was 16.00 dollars which the sponsor finds cost-effective. The process measures included the number of times the QIPC successfully sent text message reminders and the number of text messages responded to by the patients. The "Yes" response was validated by comparing whether the "Yes" response positively correlated with the mammogram results uploaded into the EHR. The primary outcome included the total number of completed mammogram results uploaded in the EHR at the end of the 15 weeks (**See Table 1 & Figure 3**).

Ethical Consideration

The project received a formal determination from the Research Protections Office (HRPO) of the Institutional Review Board (IRB) as non-human subject research prior to QI project implementation. Staff training and data collection from electronic health records and Google Voice were conducted in person, in a private area free from distractions using HIPAA privacy practices. The project's data collection and analysis were conducted in REDCap, a HIPAA-compliant, password-protected server only accessible to QIPL. Paid Google Voice also met HIPAA compliance, and text messages are encrypted. The data extracted for analysis were coded to protect confidentiality. Only the QIPL had access to the identifiable raw data. The design of this QI project was intended to improve the mammogram screening rate at the clinic. All eligible patients had registered cell phone numbers in the HER, and the sponsor granted permission to send SMS reminders as part of the QI project. The outcomes are not generalizable to other

settings/populations because the project was specifically designed to address the clinic's resources, practice gap, and workflow. QIPL analyzes project data weekly, provides aggregated data to the site stakeholders for weekly project monitoring and evaluation of the quality improvement effort, and presents externally only with site permission.

Results

The QIPL spent the first week of September on staff education and ensuring all the structures and resources were in place for the project to go live on time. The project went live on Tuesday, September 06, 2022, the second week of September. For this project, a week was defined as five business days, from Monday to Friday. In terms of structure outcome, the Google Voice service was successfully installed, and the project champion was trained in using Google Voice service prior to the start of the QI project. Education pamphlets were allocated to all patients' rooms, ready to be provided to the patients during their clinic visits. The project leader ensured that the supply of educational pamphlets in each patient room was adequate each week.

Twenty-eight patients met the eligibility criteria for the QI project. Of the 28 eligible patients, 93% (n=26) received text message reminders during the 15 weeks. The remaining two patients completed the mammogram before sending the text message reminder. Hence the two patients were not sent text message reminders, but their mammogram results were uploaded into the EHR. Out of the 26 participants who received text message reminders, 38% (n=10) responded "Yes," indicating that they had scheduled their mammogram; 12 patients did not respond to text message reminders, and four patients responded "No," indicating that they have not scheduled their mammogram. All 12 patients who did not respond and responded "No" to the text message reminders received three reminders in total. In addition, patients were provided educational pamphlets on breast cancer screening during the clinic visit.

Of the 28 patients, including two who did not receive text message reminders, 32% (n=9) completed their annual mammogram successfully. However, of the 26 participants who received text message reminders, 27% (n=7) completed the mammogram screening, an increase of 145% compared to the baseline (11%), as seen in **Bar Graph 1**. From **Run Chart 1**, during the first 11 weeks, 5 data points were above the median value, and four were below the median value indicating more patients completed their mammogram following text message reminders. Similarly, from 11 to 15 weeks, no data points were noted above the median value indicating significantly lower mammogram completion during the last four weeks. Due to limited data points, trends and shifts in the run could not be analyzed, so special-cause variation could not be established. Primary facilitators included providers who acted as early adopters. They helped disseminate the QI project to the staff. The IT support helped streamline search functions for data gathering from the EHR. The primary barrier was scheduling mammogram appointments with outside radiology clinics and the inability to track mammogram schedules. The sponsor agreed that at $16 per month with unlimited text message service, the cost of implementing Google Voice was economical and sustainable for the long term.

Discussion

There was a 145% increase in the annual mammogram screening participation rate (27%) among women 45 to 54 years old who were overdue for their annual mammogram compared to the baseline participation rate (11%). In Kerrison et al. (2015) RCT, breast screening uptake was much higher at 64.4% in the text message reminder group compared to the QI participation rate of 27%. However, the sample size of the patients who received text message reminders in Kerrison et al. was significantly larger (n= 456). In addition, the study was conducted for significantly longer, from November 2012 to October 2013. This QI project did not collect data on when the

patients planned to schedule their mammograms after the clinic visit. For instance, during the last week of the QI project, two of 4 eligible patients responded "Yes" to scheduled mammograms. However, it was also the end of the QI project, and the data for completed mammogram results could not be obtained within the QI period. Knowing how far along the mammogram has been scheduled could have allowed the QI project to capture the mammogram completion rate accurately. A longer duration of data of at least six months to a year could provide more accurate data.

Compared to the County's annual mammogram screening rate (42%), the clinic's participation rate was lower by nearly 50% during the 15-week QI project. The gap in the screening rate between the clinic and the County could be multifactorial, relating to age differences and social determinants of health (Fallahian et al., 2022). For example, uninsured women and recent immigrants have the lowest prevalence of mammography use. At the same time, Blacks, when compared to other race have poor outcomes from breast cancer (Fallahian et al., 2022). The County's rate was also based on female Medicare patients ages 65-74. A study by Moss et al. (2020) showed an over-screening among older adults, especially in a Metropolitan area.

The new search function within the EHR created by the IT to collect data on eligible patients and their phone numbers significantly improved the productivity of the project champion to quickly find eligible patients and send text message reminders through the Google Voice service. The time to find eligible patients and send text message reminders was from 5 min to 15 min, significantly less than the 30 min initially designated. In addition, even though all eligible patients had cell phone numbers, if they changed their cell phone numbers or if they changed their providers during the QI period was not known. These factors should have been accounted for during data collection and could have impacted the data.

The Google Voice service costs $16 monthly with unlimited text message service. The text message service, which currently provides the EHR service to the clinic, charges $31.50 for 500 messages, $63 for 1000 messages, $94.50 for 1500 messages, and $189 for 3000 messages (Hence, compared to the lowest price charged by, the Google Service was cheaper by 50%. The sponsor also agreed with the cost-effectiveness of the Google Service.

Of the ten patients who scheduled their mammogram, 70% (n=7) completed it. The patients who responded "No" or did not respond to all three text messages did not complete the mammograms. The intention to change behavior, as evidenced by the scheduled mammogram, resulted in a positive behavior outcome resulting in the completion of the mammograms. There was a moderate positive correlation between the scheduled and completed mammograms $r(13)=0.71$, as seen in **Figure 3**. This finding was also consistent with the Buttenheim et al. (2022) study, where the messages that increased the likelihood of patients' intention to be vaccinated also increased the vaccination behavior ($p<.001$). Based on HBM, the patients' need to schedule preventive mammogram screening is low if they have recently completed their annual preventive mammogram (LaMorte, 2022). To minimize the bias in the data collection due to the lack of intention to screen, only the patients who had the last mammogram overdue for at least one year were selected, which also met the ACS recommendation for an annual mammogram for women 45-54 years old.

Conclusion

Compared to the baseline data, the increase of 145% in the annual mammogram participation rate shows that text message reminder is a cost-effective method to improve annual mammogram screening participation among women 45-54 years. The findings from the QI project could be spread to other future QI projects to improve primary and secondary screenings and

patients' self-care behaviors. For example, the clinics could report breast cancer screening rates as part of electronic clinical quality measures to show the health care quality at the clinic (eCQI, 2023). Out of the 28 patients, the fact that 93% (n=26) received text message reminders positively impacted the process change. The clinic staff and the QI team members contributed to the process change.

Annual staff education and competencies should be provided on the importance of breast cancer screening, data collection from the EHR, and using Google Voice to send timely text message reminders. The cost-effectiveness and user-friendliness of the Google Voice service support the project's long-term sustainability. The willingness of the providers, who are the early adopters of the QI project, to influence the staff in breaking the resistance to process change was a significant facilitator for the QI project. However, even though Google Voice service is a cost-effective method of sending text message reminders, the long-term goal should be to find ways to integrate automated text message reminders with electronic mammogram orders. An automated text message service will save the staff time collecting data and sending text messages. The patient portal is also a cost-effective method to send text message reminders to patients.

As one of the first student-led QI projects in the clinic, the success of this QI project will set a precedent for future QI projects and encourage the utilization of evidence-based practice in the clinical setting to affect improved patient outcomes and process improvement.

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Appendix A. Updated Process Map

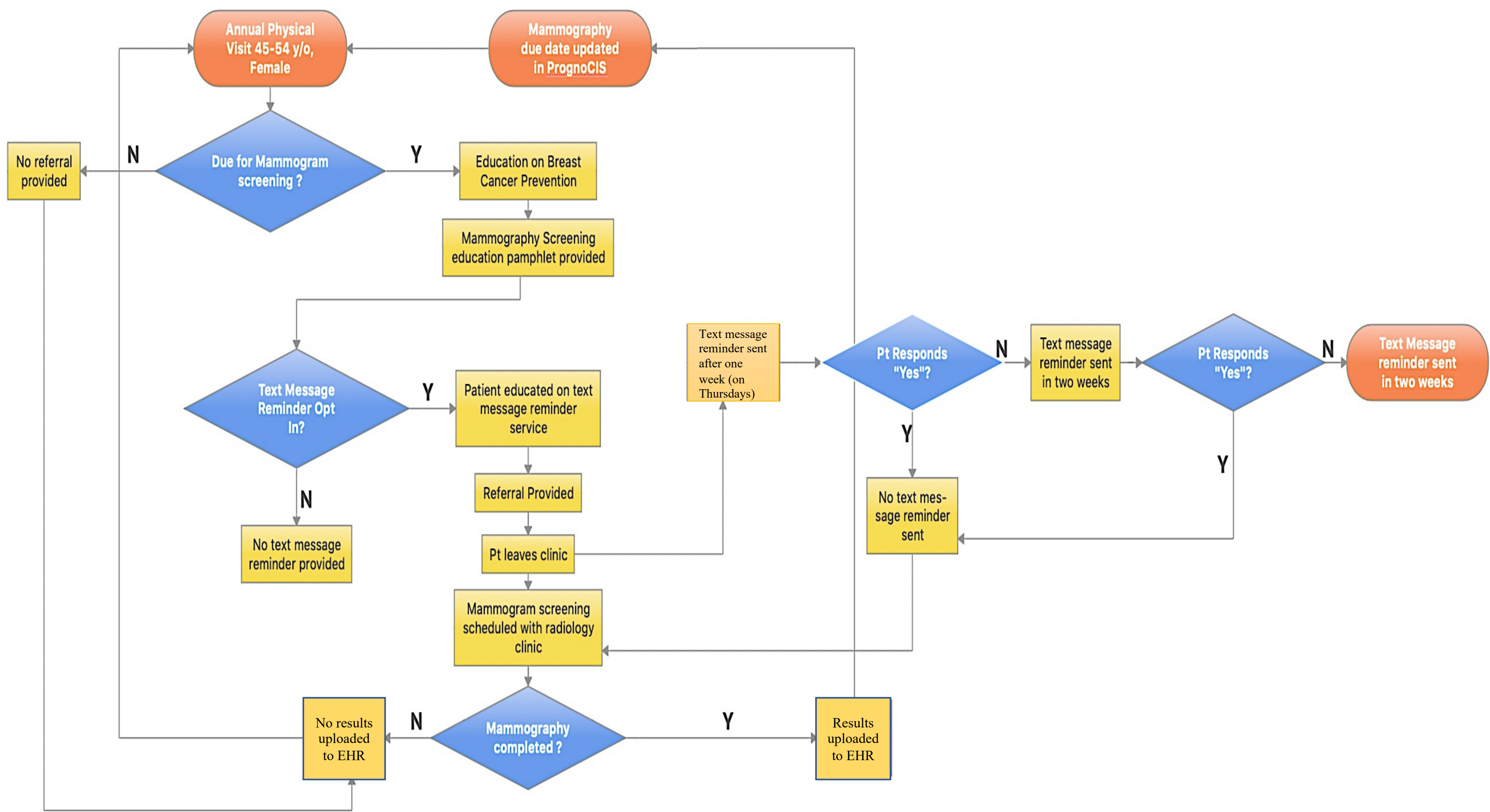
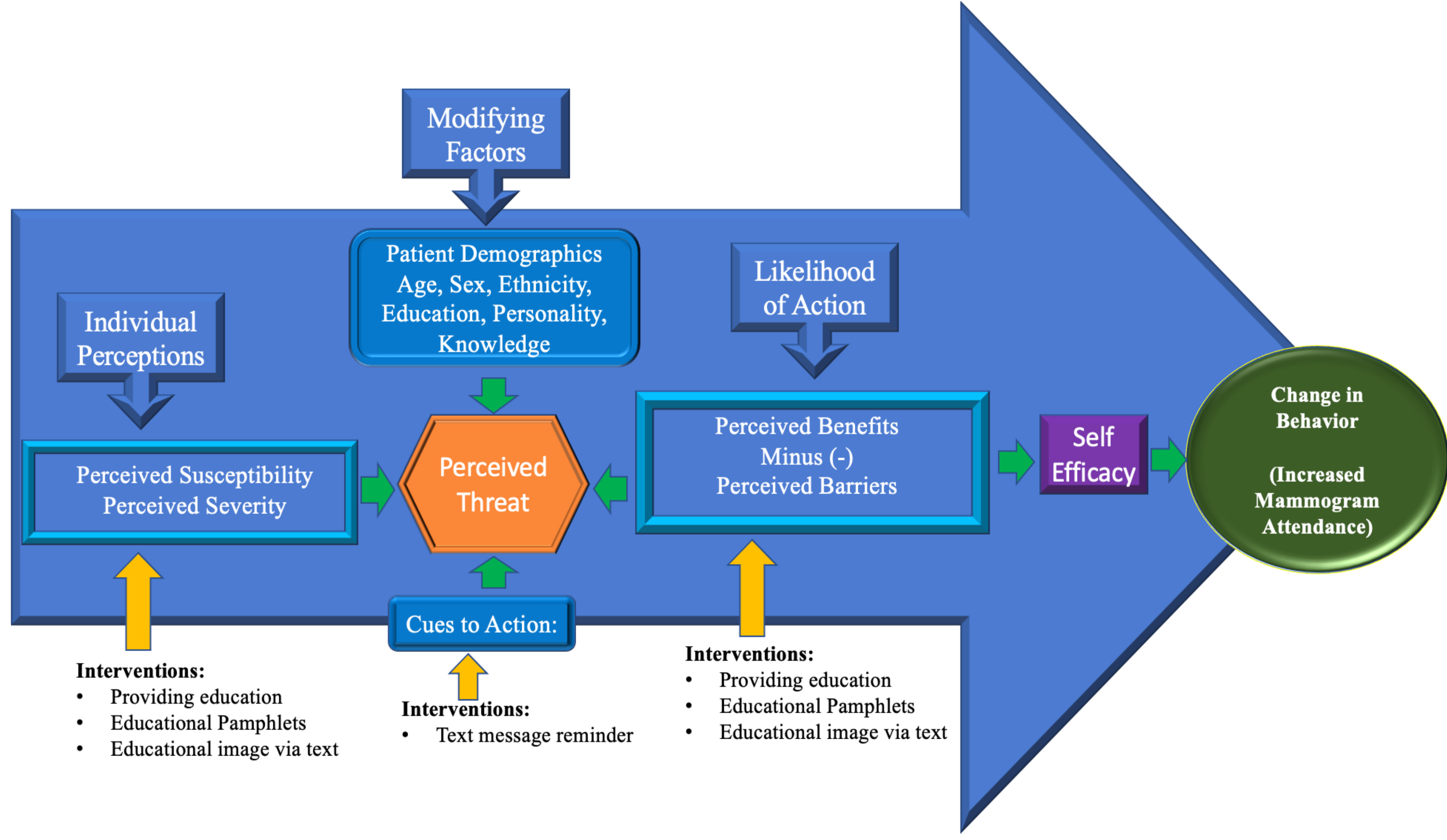


Figure 1. Implementation Science Framework



Appendix B. Current Process Map

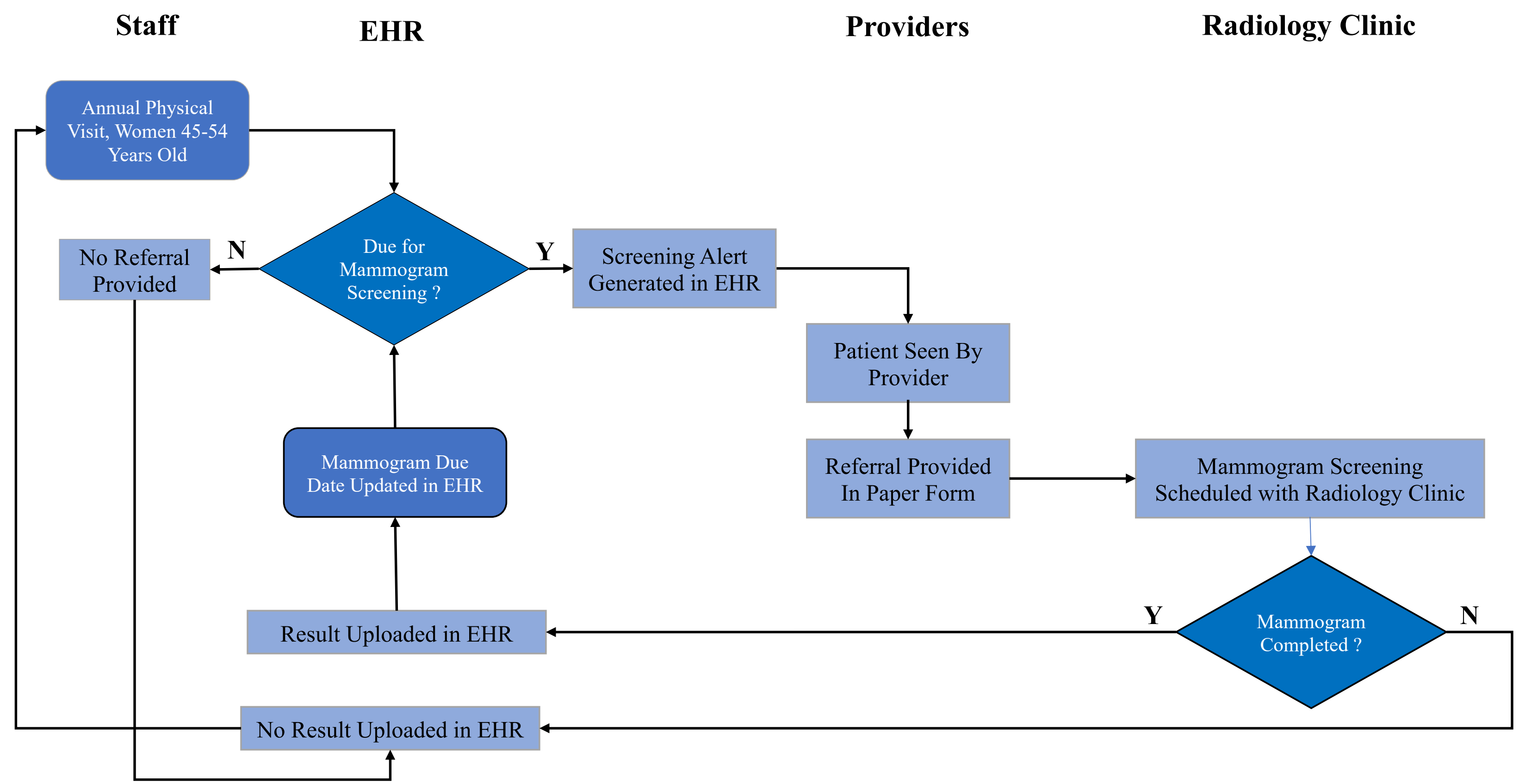
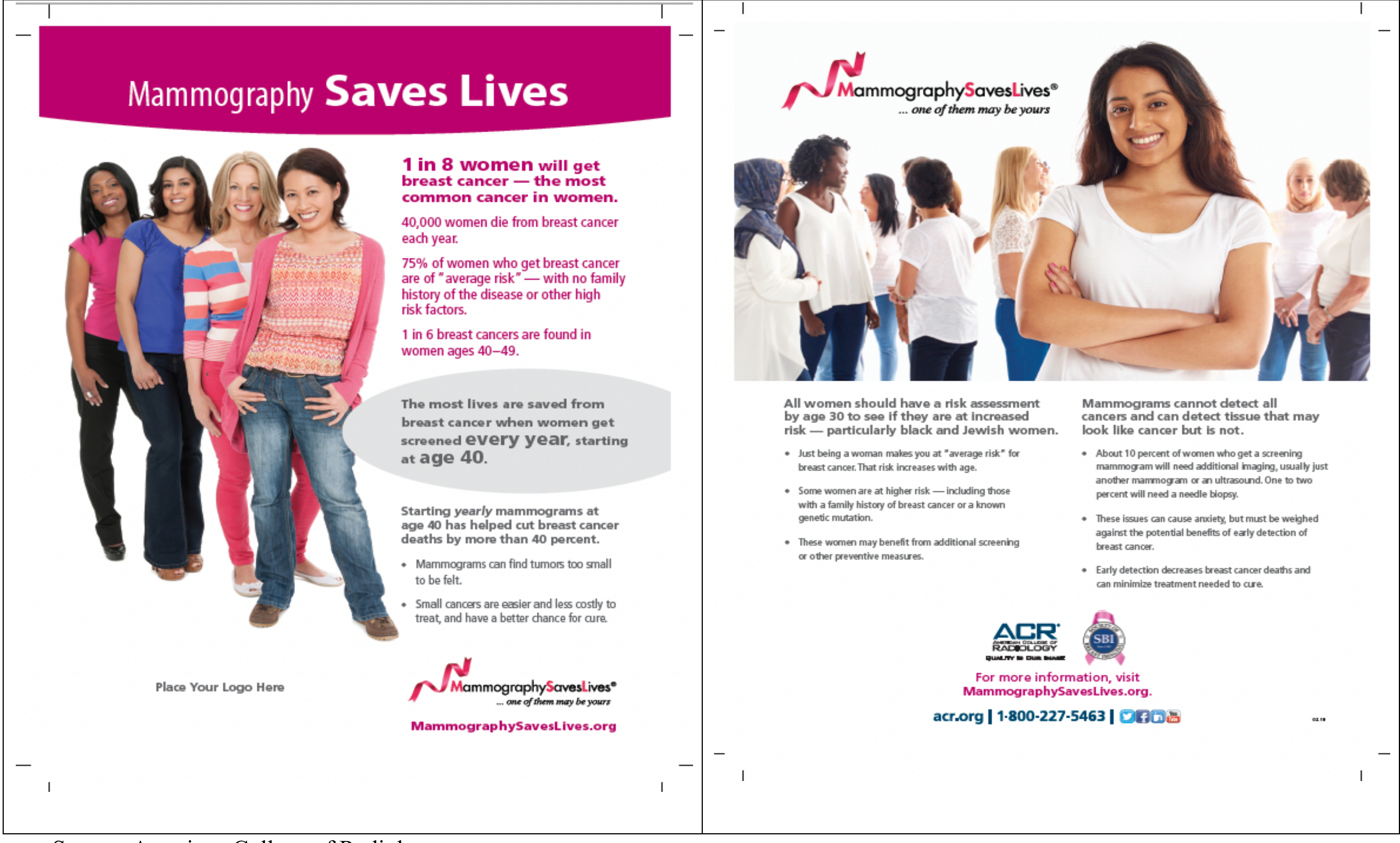


Figure 2. Template for Educational Pamphlet



Source: American College of Radiology

Bar Graph 1. Comparison of Mammogram Completion Rate

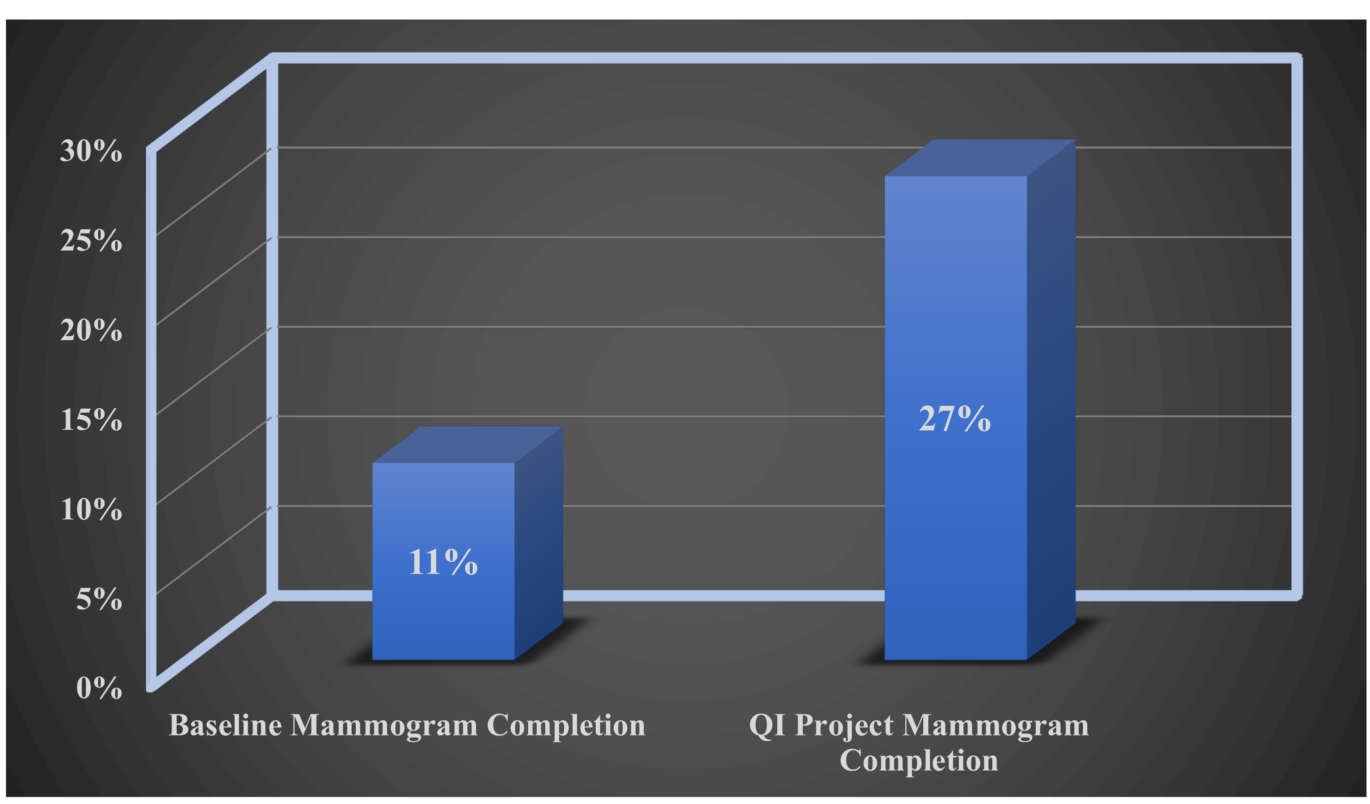


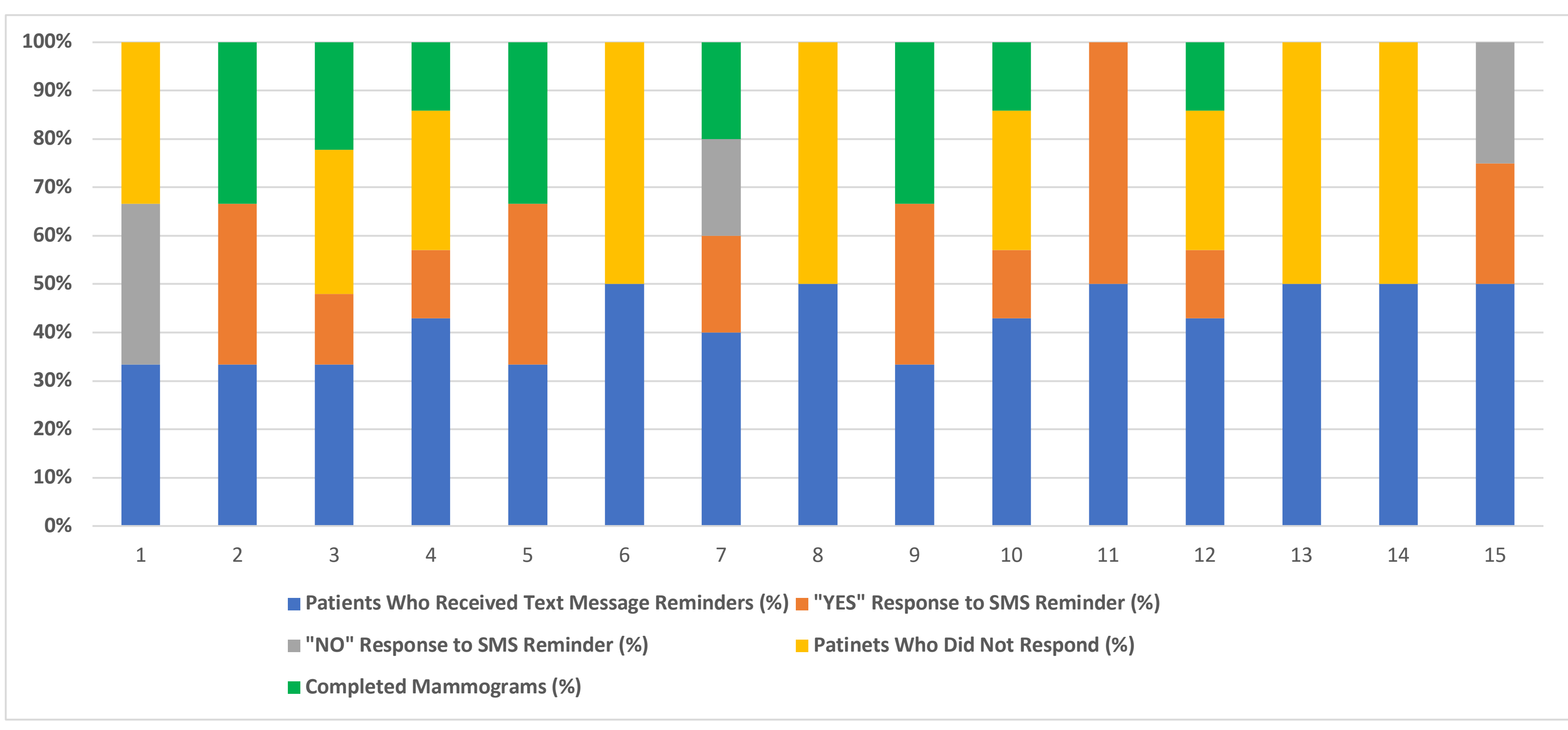
Table 1.

TEXT MESSAGE REMINDER TO IMPROVE MAMMOGRAM SCREENING PARTICIPATION

Week	**Eligible Participants (N)**	**Patients Who Received Text Message Reminders (%)**	**"YES" Response to SMS Reminder (%)**	**"NO" Response to SMS Reminder (%)**	**Patients Who Did Not Respond (%)**	**Number of Text Messages Tries (N)**	**Completed Mammograms (%)**
1	2	50	0	**50**	**50**	3	0
2	1	100	**100**	0	0	3	**100**
3	4	75	**33**	0	**67**	7	**50**
4	1	100	**33**	0	**67**	3	**33**
5	1	100	**100**	0	0	1	**100**
6	2	100	0	0	0	6	0
7	2	100	**50**	**50**	0	4	**50**
8	1	100	0	0	**100**	3	0
9	1	100	**100**	0	0	1	**100**
10	3	100	**33**	0	**67**	7	**33**
11	1	100	**100**	0	0	2	0
12	3	100	**33**	0	**67**	7	**33**
13	1	100	0	0	**100**	3	0
14	1	100	0	0	**100**	3	0
15	4	100	**50**	**50**	0	8	0
Total	**28**					**61**	

Note: Eligible participants include women 45-54 years who attended annual physicals and are overdue for mammogram screening by more than a year. "**YES**" indicates patients have scheduled their mammogram. "**NO**" indicates patients have not scheduled their mammogram.

Figure 3. Text Message Reminder to Improve Annual Mammogram Screening Participation



Run Chart 1. Percentage of Completed Mammograms During 15 weeks QI Period

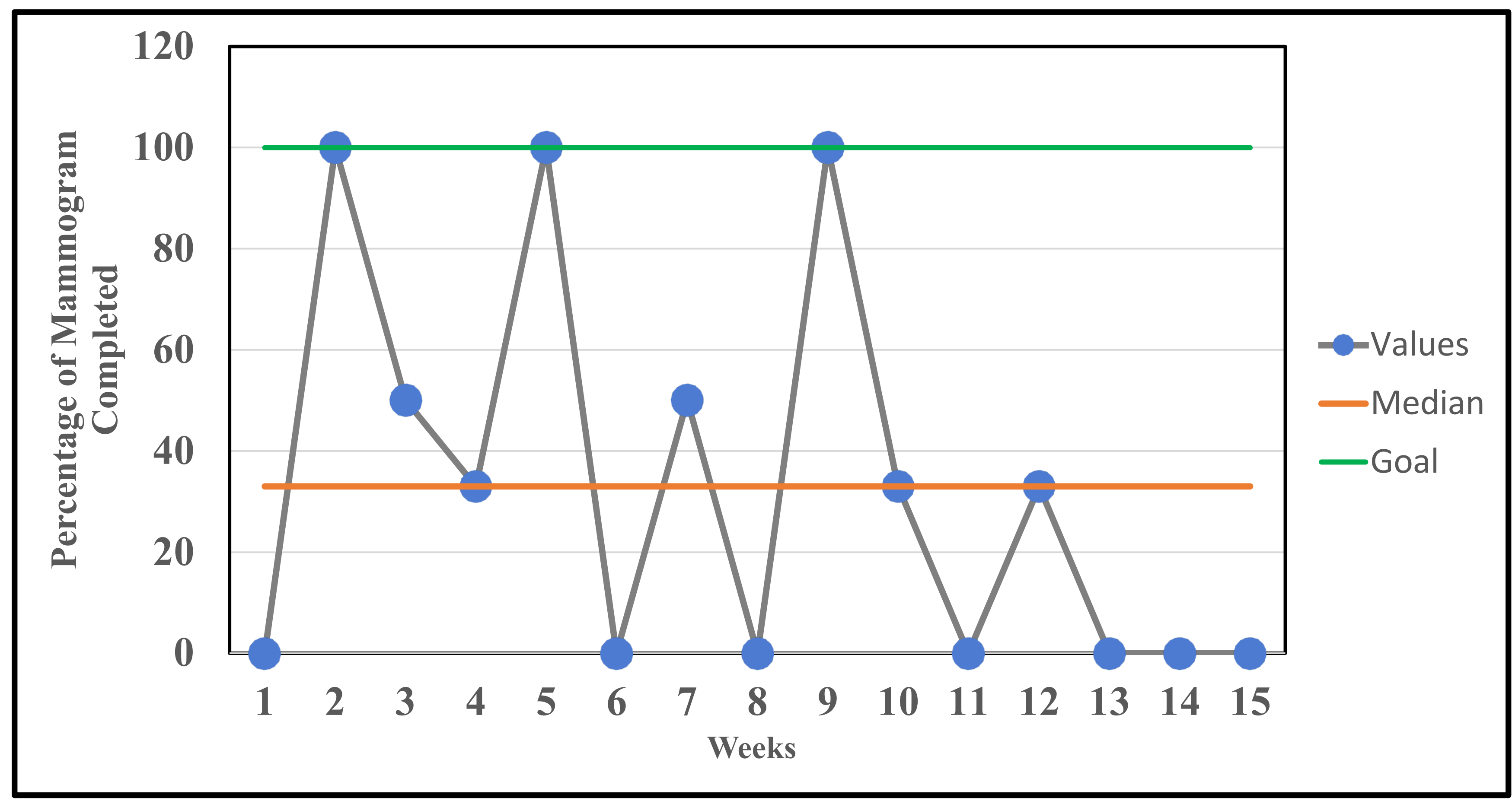
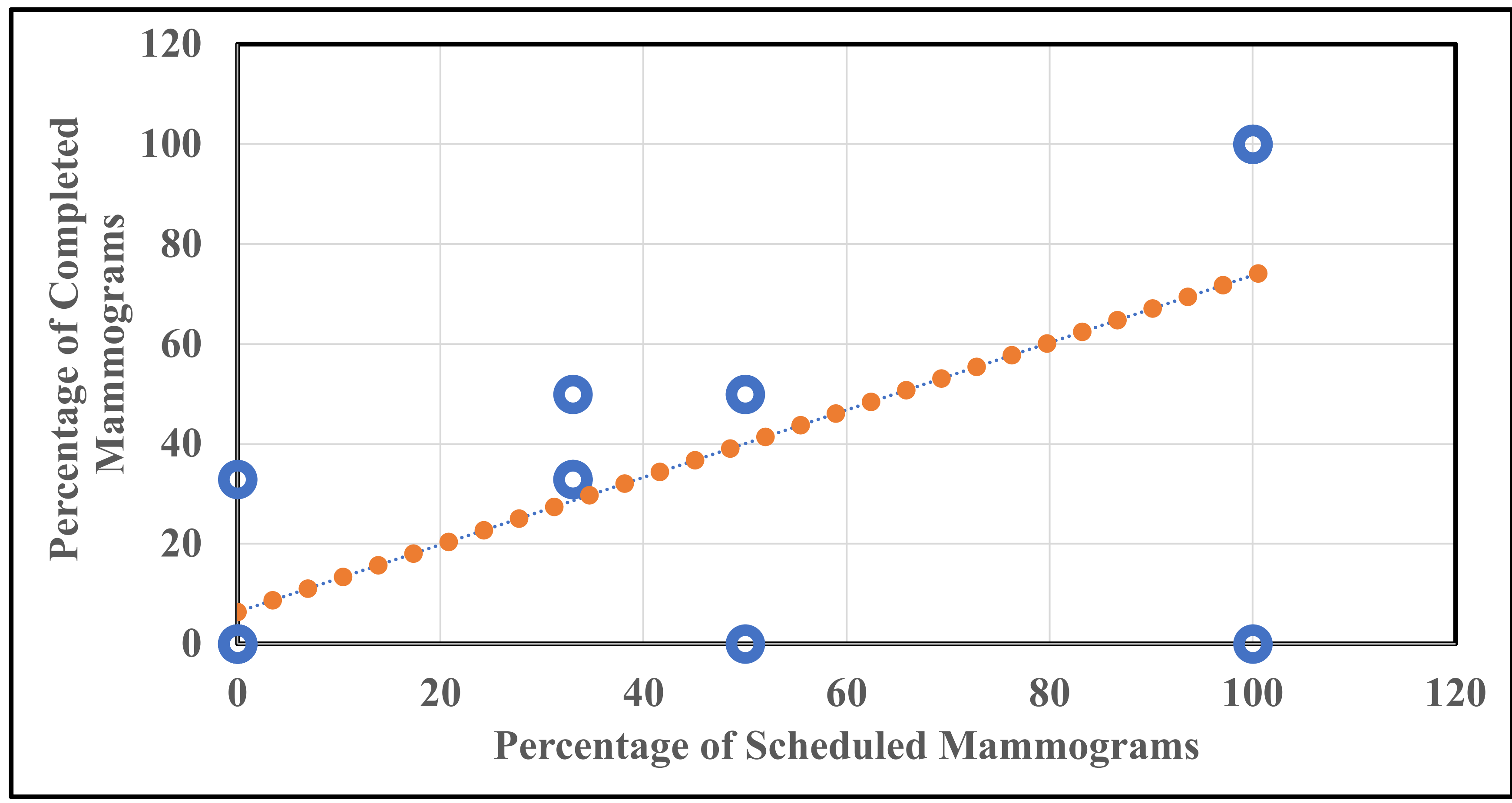


Figure 4. Correlation between Scheduled and Completed Mammograms



Appendix B. Evidence Review Tables

Citation: Buttenheim, A., Milkman, K. L., Duckworth, A. L., Gromet, D. M., Patel, M., & Chapman, G. (2022). Effects of ownership text message wording and reminders on receipt of an influenza vaccination. *JAMA Network Open*, *5*(2). https://doi.org/10.1001/jamanetworkopen.2021.43388					**Level and Quality** **I-A**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of the study is to assess the effect of text-message reminders on the influenza vaccination rate when the text message reminded them that their influenza vaccination had been reserved for them.	Research. Prospective. RCT	**Sampling Technique**: Random Sampling **Setting:** 2 large healthcare systems, USA **Eligible Participants**: Adults with upcoming primary care appointments due for influenza vaccination (n=13835). **Inclusion**: • Cell phone number recorded in the electronic health record • Had not opted out of receiving SMS reminders • No documented allergy/adverse reaction to influenza vaccination • Had not received influenza vaccination in the 2020-2021 flu season **Exclusion**: Vaccination before the appointment and canceled appointments **Accepted:** 11185 Control: 3432/3742 (310 were excluded; 0 lost to follow-up and discontinued from intervention) **Intervention 1**: 3375/3737 (362 were excluded; 0 lost to follow-up and discontinued from intervention) **Intervention 2:** 3351/3709 (358 were excluded, 0 lost to follow-up and discontinued from intervention) **Power Analysis:** The study states that the sample size met 80% power in both intervention groups. **Group Homogeneity:** Participants had a mean (SD) age of 50.61 (16.28) years; 5631 (55.43%) were women, and 7025 (69.16%) were White.	**Control:** No pre-appointment text messages were sent **Intervention Protocol 1**: A pre-appointment text message reminding them "a flu shot has been reserved for you" was sent to the participants. **Intervention Protocol 2:** Pre-appointment text message reminding them "flu shot will be available" was sent to the participants. Both groups received a sequence of 3 back-to-back SMS messages the evening before their appointment, which included in order: 1. Appointment reminder 2. Photograph of vaccine with "your flu dose." 3. "Reserved for you" or "Available" with the requested response of Yes(Y) or No (N). **Intervention fidelity** The institutional review board approved RCT at the University of Pennsylvania.	**DV**: Influenza vaccination **DV Measurement:** Influenza vaccination rate. No information was available on what instrument or tool was utilized for outcome measure.	**Statistical Results** There was no significant difference in influenza vaccination rate between patients who received a "reserved" (34.61%) vs. "available" (33.21%) text message, an increase of 1.4% (p=.31). However, when comparing between patients who received a "reserved" (34.61%) vs. usual care or no text message (31.21%), the "reserved" message increased vaccination rates by 3.3% points or 11% (p=.004). Patients who replied Y to text messages were more likely to get vaccinated (78.56%) than compared with those who did not (15.68%); $\chi^2 = 2400$; $P < .001$). **Conclusions** Text message reminders increased influenza vaccination uptake compared to those who did not receive it. In addition, text messages which increased the likelihood of patients indicating their intention to get vaccinated, also increased vaccine behavior.

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

<table>
<tr><td colspan="5">Citation: Gurol-Urganci, I., de Jongh, T., Vodopivec-Jamsek, V., Atun, R., & Car, J. (2013). Mobile phone messaging reminders for attendance at healthcare appointments. Cochrane Database of Systematic Reviews. https://doi.org/10.1002/14651858.cd007458.pub3</td><td>Level and Quality
I-A</td></tr>
<tr><td>Purpose/ Hypothesis</td><td>Type of Evidence Research Design</td><td>Sample – Population, Size, Setting</td><td>Intervention/Procedures</td><td>Primary Outcome/ Measures</td><td>Results/Conclusions</td></tr>
<tr><td>The primary purpose of this research study was to assess the effect of text message reminders on healthcare appointments .</td><td>Research; Prospective: Systematic Review</td><td>Sampling Technique: Electronic databases were searched: Cochrane Central Register of Controlled Trials, (CENTRAL, The Cochrane Library) MEDLINE (OvidSP), EMBASE (OvidSP), PsycINFO (OvidSP), CINAHL (EBSCOhost), and grey literature (including trial registers) and reference lists of articles. The search identified 2876 unique citations, and 660 were retained for relevance to the reviews. 355 citations were excluded based on study design, abstract and insufficient relevance. 129 citations were fully reviewed, plus additional 25 trial protocols and conference abstracts. 94 failed to meet the inclusion criteria. 8 RCTs were selected for the final review after allocating papers across two parallel reviews.
Setting: primary, hospital, community, outpatient
Eligible Participants: Age ranged from 29-59; in 7 studies, eligible participants included those who required appointments and had access to mobile with text messaging capability; in 1 study, eligible participants included those with a history of ≥2 missed appointments within 1 year. 7 studies included male and female participants, whereas 1 study included male participants.
Inclusion: RCTs assessed the effect of text messaging on healthcare appointments independent of other technologies or interventions.
Exclusion: SMS/MMS used as part of a multifaceted intervention; SMS sent for routine drug collection
Accepted: 8 RCTs involving 6651 participants
7 seven studies compared SMS reminders to no reminders
Control: 1977/2918 with no reminder events
Intervention: 2276/2923 SMS reminders events
Studies Heterogeneity:
In the 7 seven studies that compared text messaging to no reminders, high heterogeneity ($I^2 = 90\%$) was noted due to the large effect estimate of one study (Lin 2012). However, a sensitivity analysis without Lin 2012 still showed SMS reminders improved attendance rate compared to no reminders.</td><td>Control:
Among the 8 RCTs, in 7 studies, the control group was patients who received “no reminders as usual practice.” In one study, the control group was patients who received “postal reminders," whereas in one study had two control groups: "no reminders" and "phone call reminders."

Intervention:
In all 8 RCTs, the intervention group was those that received SMS (short message service) reminders through various platforms. Depending on the studies, patients received text message reminders either 24 hours, 24-28 hours, or 72 hours before the appointment.

Intervention fidelity
Access to the original study protocol from the studies was not available. Various platforms were used to send text messages in each study. All studies were randomized.</td><td>DV: Healthcare appointments

DV Measurement
All studies' outcome was measured using the attendance rates at healthcare appointments.

No instrument or tool was utilized for outcome measure.</td><td>Statistical Results
Text message reminders improved the rate of attendance at healthcare appointments compared with no reminders (RR 1.14; 95% CI 1.03 to 1.26) in 7 studies (Chen 2008, Fairhurst 2008, Leong 2006, Liew 2009, Lin 2012, Odeny 2012 & Taylor 2012; 5841 participants)

Conclusions
The systematic review of the studies concluded that mobile phone text messaging reminders increased attendance at healthcare appointments compared to no reminders.</td></tr>
</table>

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

Citation: Icheku, V., & Arowobusoye, N. (2015). Evaluation of a service intervention to improve uptake of breast cancer screening in a London Borough with many hard-to-reach communities. *Universal Journal of Public Health*, *3*(2), 97–102. https://doi.org/10.13189/ujph.2015.030207					**Level and Quality** **II-B**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The primary purpose of this research study was to assess the effect of text message reminders on breast cancer screening in hard-to-reach communities.	Research; Prospective: Non-randomized experimental design	**Sampling Technique**: Convenience sampling **Setting**: General Practices (GP), Royal London Borough of Greenwich, England **Eligible Participants**: Women 50-70 years old (n=2,004) from 11 GPs who were invited for screening between July and December 2011 **Exclusion**: Women with a diagnosis of colorectal cancer, bowel cancer, palliative care needs, or those who had declined to participate in the program **Accepted:** 2,004 **Control:** Usual Care (letter invitation; n=1452) **Intervention**: Letter invitation + text message reminder (n=552) **Group Homogeneity:** Unable to ascertain the homogeneity of the participants as no information was available on the population demographic distribution. Table 1 did not provide information on sample demographic distribution.	**Control**: Invitation letters were sent to the participants from each GPs using the letter designed by Greenwich Primary Care Trust, an independent regulator of health and social care in England. **Intervention**: Along with the invitation letters, SMS reminders were sent to the participants using the iPLATO Healthcare Limited Patient Cate Messaging application installed at 11 participating GPs, a week before their appointment. **Intervention fidelity** GPs were not involved in sending either the invitation letters or SMS and were unaware of which participants received either the letters or SMS.	**DV**: Breast cancer screening **DV Measurement** Breast cancer screening uptake The data was compiled by Southeast London Breast Cancer Screening Service (SEBLSS). However, the study does not specify what instrument or tool was utilized to gather the data. iPLATO was used to analyze the data provided by SEBLSS.	**Statistical Results** In the control group, who were only sent invitation letters (n=1452), the number of women screened was (n=878, 60%). In the intervention group (n=552) who were sent invitation letters and SMS reminders, the number of women screened was (n=376, 68%). There was an 8% differential rate between the two groups, resulting in 44 additional women being screened because of SMS reminders. Compared to similar months in 2011, there was an overall 2.54 %-point increase in breast cancer screening uptake. **Conclusions** When compared to the conventional invitation letter, an SMS reminder is more effective in increasing breast cancer screening uptake among women in hard-to-reach communities in the London Borough.

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

<table>
<tr><td colspan="5">Citation: Kerrison, R. S., Shukla, H., Cunningham, D., Oyebode, O., & Friedman, E. (2015). Text-message reminders increase uptake of routine breast screening appointments: A randomized controlled trial in a hard-to-reach population. British Journal of Cancer, 112(6), 1005–1010. https://doi.org/10.1038/bjc.2015.36</td><td>Level and Quality
I-A</td></tr>
<tr><td>Purpose/ Hypothesis</td><td>Type of Evidence Research Design</td><td>Sample – Population, Size, Setting</td><td>Intervention/Procedures</td><td>Primary Outcome/Measures</td><td>Results/Conclusions</td></tr>
<tr><td>The primary purpose of this research study was to determine if text reminders increase the uptake of breast cancer screening appointments.</td><td>Research; Prospective: Two-arm, Single-blinded RCT</td><td>Sampling Technique: Random sampling
Eligible Participants:
2294 women ages between 47 to 53 who were due for their first routine breast screening in the London Borough of Hillington (LBH) during the trial period (November 2012–October 2013)
Setting: London Borough of Hillingdon (LBH), London, England
Exclusion: All interval cancer cases, GP referrals, self-referrals, male appointments, and other non-routine appointments. 54 participants were excluded due to an opt-out request.
Accepted: 2240 participants
Control: 1118 (no reminder group)
Intervention: 1122 (text message reminder group). However, only 380 participants received text messages (only 456 had mobile phone numbers recorded, 76 were expired).
Power analysis
2234 subjects required to meet 80% power, a one-tailed difference of 5%, and 5% margin of error – Power Analysis met
Group Homogeneity: Based on Table 1, population distribution appeared to be homogenous. The majority of the population resided in deprived regions, as shown by the majority falling between IMD scores of 2 to 4.</td><td>Control Protocol: Women were invited to breast screening in a standard office hour appointment, without reminder, as per usual care.
If women canceled, did not attend (DNA), and did not schedule, a DNA letter was sent, which offered an 8-week window to book an appointment.

Intervention Protocol: Women were invited to standard office hour appointments but also received text message reminders 48 hours before the appointment. The text message reminder included a date, time, and venue of their appointment and rescheduling information if unable to attend. Participants who DNA their breast screening appointment received additional DNA text messages. Participants who scheduled a new appointment received an additional text message reminder 48 hours before the appointment.

Intervention fidelity
Participants were randomly assigned. Participants knew they were being included in the experimental trial, which could affect patients' decision to attend mammography.</td><td>DV: Breast cancer screening appointment

DV Measurement
The number of breast cancer screening appointments following text message reminder.

Information was unavailable on the instrument or tool utilized for outcome measure.</td><td>Statistical Results
Breast screening uptake was higher (64.4%) in the text-message reminder group when compared to the normal invitation group (59.1%) in the intention-to-treat analysis (χ^2=6.47, odds ratio (OR): 1.26, 95% confidence intervals (CI): 1.05–1.48, P=0.01).

Conclusions
Sending women a text message reminder before their first routine breast screening appointment significantly increased attendance.

Text message reminders had the biggest impact on women from the most deprived areas, who were 28 percent more likely to attend their first screening appointment if they were sent a text.</td></tr>
</table>

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

Citation: Vidal, C., Garcia, M., Benito, L., Milà, N., Binefa, G., & Moreno, V. (2014). Use of text-message reminders to improve participation in a population-based breast cancer screening program. *Journal of Medical Systems*, *38*(9). https://doi.org/10.1007/s10916-014-0118-x					**Level and Quality** **II-B**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this study was to analyze the effect of a cell text message reminder service on participation in a mammogram screening program.	Research, A quasi-experimental design	**Sampling Technique**: Convenience sampling **Setting:** Catalonia, Southern Barcelona Metropolitan Area **Eligible Participants**: Women aged 50 to 69 years **Inclusion:** Information not available **Exclusion**: Information not available **Accepted:** 12,786 women with scheduled mammogram appointments between June 13, 2011, to July 12, 2011. **Control**: Women without cell phone numbers (n=9067) **Intervention:** Women who had their cell phone registered with the National Health Service (n=3719) **Power Analysis:** Information was not available **Group Homogeneity:** Unable to ascertain the homogeneity of the participants as no information was available on the population demographic distribution. Table 1 did not provide information on sample demographic distribution.	**Control Protocol**: Women who did not have their phones registered with the National Health Service received a letter. If an appointment change was requested, participants would reschedule via phone and be allowed the preference to select the date and time of the appointment. **Intervention Protocol**: Women who had their phone registered with the National Health Service received a text message reminder 3 days before their scheduled appointment, in addition to a standard letter. Text messages were sent using an outsourcing company (ALHORA Solutions) If an appointment change was requested, a new SMS with preconformed appointment date was sent. **Intervention fidelity** The Clinical Research Ethics Committee of the Bellvitge University Hospital approved the study protocol, and all involved parties followed ethical standards established by the Spanish Organic Law on the Protection of Personal Data. There was no randomization of the participants.	**DV**: Participation in the mammogram screening program **DV Measurement:** Number of participants who attended the mammogram screening program No information was available on what instrument or tool was utilized for outcome measure.	**Statistical Results** A total of 74.9 % of the women who received the SMS reminder and 65.0 % of the women who only received the invitation letter attended their appointments (OR=1.63, 95 %CI: 1.49–1.78). Among women living in areas with difficult access to postal mail service and without a history of prior screening, text message reminders increased attendance to mammogram screening programs (OR=2.85; 95 %CI: 2.31–3.53) compared to those who lived in areas of easier postal mail access (OR=1.66; 95 %CI: 1.36–2.02). **Conclusions** Text message reminders are a cost-effective method to increase participation in mammogram screening in difficult-to-reach areas and increase the likelihood of participation among women without prior history of screening by double.

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

Citation: Anthony, N., Molokwu, J., Alozie, O., & Magallanes, D. (2019). Implementation of a Text Message to Improve Adherence to Clinic and Social Service Appointments. *Journal of the International Association of Providers of AIDS Care*, *18*, 2325958219870166. https://doi.org/10.1177/2325958219870166					**Level and Quality** **IIB**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this study was to implement and evaluate the use of Google's text messaging service in improving appointment adherence of patients at an HIV clinic in Texas.	Experimental study Pre-post intervention	**Sampling Technique:** Convenient sample # eligible: no data # accepted: no data # in control: 326 # in intervention: 243 **Power analysis**: Not done **Group Homogeneity**: Mean age 40yrs. The majority of patients were males of Hispanic origin. Pre-post demographic data were not significantly varied.	**Control** **-**No reminder system - Patients were reminded of the future appointment at the time of scheduling. **Intervention** -Google Voice reminder system via text messaging. **Intervention fidelity** The clinic social worker and medical assistant send reminder text messaging to the patients 3 days before the appointment via Google Voice service. Preformatted text messages were in English and Spanish. Participating patients must sign a consent form to use their phone numbers for text messaging. Patients had the option to text back to reschedule or cancel the appointment.	DV: Reduction in no-show rate to follow-up appointments. **Instrument:** The analysis was done using SAS software (SAS Institute Inc, Cary, North Carolina). **Reliability:** No data **Measurement procedure:** **-**Descriptive statistics were used to report demographic data: age, gender, and language. -Rate of attendance: using the percentage of patients who did and did not attend the appointment. -Pre-intervention data regarding follow-up adherence rates were collected 6 months before from May-Dec 2013. -Post-intervention 6-month data were collected from Jan-July 2014.	**Statistical Results** -In the pre-intervention period: 245 patients out of 326 attended the appointment. The no-show rate was 24.85%. -Post-intervention period: 200 patients out of 243 attended their appointment. The no-show rate was 17.7%. **Clinical Significance** There was a statistically significant increase in appointment adherence of 7.15% (p=0.05) **Conclusions:** Utilizing the free Google Voice text messaging reminder within the clinical setting increased the attendance rate. Again, this intervention is easy to implement without costly measures.

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

Citation: Orr, J. A., & King, R. J. (2015). Mobile Phone SMS Messages can Enhance Healthy Behaviour: A Meta-analysis of Randomised Controlled Trials. *Health psychology review*, *9*(4), 397–416. https://doi.org/10.1080/17437199.2015.1022847					**Level and Quality** **IIB**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
This meta-analysis study aims to examine the evidence regarding the efficacy of mobile phone short-message service (SMS) on enhancing healthy behavior.	Research study Meta-analysis of randomized control trials.	**Sampling Technique:** Database search on various academic search engines using keywords 'mobile phone' or 'cell phone' or 'cellular phone' or 'text messag*' or SMS or 'short messag* service' AND support or intervention or 'behav* change', 'Randomised Control Trial', 'Meta-Analysis', 'Review' and 'Systematic Reviews' # eligible: 678 # accepted: 38 articles **Power analysis**: Performed. At least 6 studies with sample size of 50 participants would be sufficient to achieve significance of a mean effect size of d=0.30 **Group Homogeneity**: Significant heterogeneity among studies.	**Control** **-**No reminder system **Intervention** SMS messages on healthy behaviors **Intervention fidelity** SMS messages were used to deliver essential behavior change methods, for example, "reminders or encouragement to perform certain actions, to obtain progress feedback, to enhance engagement and self-efficacy by reinforcing the adoption of healthy behavior and to provide a source of social support so that health consumers."	DV: Changes in healthy behaviors **Instrument:** The analysis was done using meta-analysis software- Comprehensive Meta-Analysis (version 2.2.021; Biostat, 2011) **Reliability:** No data **Measurement procedure:** **-**Descriptive statistics were used to report demographic data: age, gender, and language. -Rate of attendance: using a percentage of patients who did and did not attend the appointment. -Pre-intervention data regarding follow-up adherence rates were collected six months before from May-Dec 2013. -Post-intervention 6-month data were collected from Jan-July 2014.	**Statistical Results** There was a small, significant weighted average effect size regarding the pooled effect of SMS messages on healthy behaviors ($p<0.001$). Low heterogeneity ($p=0.009$). Multiple SMS messages per day showed a more significant effect than lower frequency. **Clinical Significance** The Q statistic and the I 2 statistics were used to examine the statistical heterogeneity between studies and their impact on the meta-analysis. **Conclusions:** SMS messaging as a reminder for healthy behavior changes is a simple and cost-efficient method that could be generalized across age groups and backgrounds. Even though the effect size is small, many RCTs showed positive effects/changes.

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

Appendix C. Evidence Synthesis Table

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings
Level 1 - Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	1 Systematic Review of 8 RCTs 2RCT 1 Meta-Analysis	A	In Orr & King (2015), SMS message reminder was found to be a simple and cost-efficient method for healthy behavior changes, and the finding could be generalized across age groups and background. Even though the effect size is small, many RCTs showed positive effects/changes. There was a small, significant weighted average effect size regarding the pooled effect of SMS messages on healthy behaviors (p<0.001). In Gurol-Urganci et al. (2013) systematic review of 8 RCTs, the study concluded that in 7 studies (Chen 2008, Fairhurst 2008, Leong 2006, Liew 2009, Lin 2012, Odeny 2012 & Taylor 2012; 5841 participants) mobile phone text messaging reminders increased attendance at healthcare appointments when compared to no reminders (RR 1.14; 95% CI 1.03 to 1.26) In the RCT study by Kerrison et al. (2015), sending women a text message reminder before their first routine breast screening appointment significantly increased attendance and increased the likelihood of attendance by 28 percent among women from the most deprived areas. In addition, breast screening uptake was higher in (64.4%) in the text-message reminder group when compared to the standard invitation group (59.1%) in the intention-to-treat analysis (χ^2=6.47, odds ratio (OR): 1.26, 95% confidence intervals (CI): 1.05–1.48, *P*=0.01). In the RCT study by Buttenheim et al. (2022), Text message reminders increased influenza vaccination uptake compared to those who did not receive. There was a 3.3 percentage points or 11% (p=.004) increase in screening uptake among the group who received text messages stating the flu vaccine is "reserved" for them (34.61%) to the group who did not receive any text message (31.21%). Text messages that increased the likelihood of patients indicating their intention to get vaccinated also increased vaccine behavior. Patients who responded Yes (Y) to text messages were more likely to get vaccinated (78.56%) than compared with those who did not (15.68%); $\chi^2 = 2400$; $P < .001$).
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.	3 Quasi-Experimental Studies	B	In Vital et al. (2014) study, 74.9% of the women who received text message reminders attended the mammogram screening program versus 65% of the women who only received the invitation letter (OR=1.63, 95 %CI: 1.49–1.78). Among women living in difficult-to-reach areas without prior history of screening, text messaging reminders increased the likelihood of mammogram screening attendance by double (OR=2.85; 95 %CI: 2.31–3.53) when compared to the women living in areas of easier postal mail access (OR=1.66; 95 %CI: 1.36–2.02).

			In Icheku & Arowobusove's (2015) study, SMS (short message service) reminder was more effective in breast cancer screening uptake among women in hard-to-reach communities when compared to the invitation letter reminder. In the control group, who only received the invitation letter, 878 out of 1452 women (60%) attended the breast cancer screening. In the intervention group who received both the text message reminder and the invitation letter, 376 out of 552 women (68%) attended the breast cancer screening. When comparing the screening uptake to similar months in the prior year 2010, there was an overall 2.54 percentage point increase in breast cancer screening uptake. In Anthony el. (2019), using the free Google Voice text messaging reminder within the clinical setting significantly impacted increasing attendance rate. This intervention is easy to implement without costly measures. There was a statistically significant increase in appointment adherence of 7.15% (p=0.05)
Level III · Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis			
Level IV · Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence			
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.			
Recommendations Based on Evidence Synthesis: Good and consistent evidence to support practice change			

Note: Johns Hopkins Nursing Evidence-based Practice Level Hierarchy; Johns Hopkins Nursing Evidence-Based Practice Quality Grade

Appendix D. Rating System

JHNEBP (Johns Hopkins Nursing Evidence-based Practice) RATING SCALES

STRENGTH of the Evidence	
Level I	Experimental study/randomized controlled trial (RCT) or meta analysis of RCT
Level II	Quasi-experimental study
Level III	Non-experimental study, qualitative study, or meta-synthesis.
Level IV	Opinion of nationally recognized experts based on research evidence or expert consensus panel (systematic review, clinical practice guidelines)
Level V	Opinion of individual expert based on non-research evidence. (Includes case studies; literature review; organizational experience e.g., quality improvement and financial data; clinical expertise, or personal experience)

QUALITY of the Evidence		
A High	Research	consistent results with sufficient sample size, adequate control, and definitive conclusions; consistent recommendations based on extensive literature review that includes thoughtful reference to scientific evidence.
	Summative reviews	well-defined, reproducible search strategies; consistent results with sufficient numbers of well defined studies; criteria-based evaluation of overall scientific strength and quality of included studies; definitive conclusions.
	Organizational	well-defined methods using a rigorous approach; consistent results with sufficient sample size; use of reliable **and** valid measures
	Expert Opinion	expertise is clearly evident
B Good	Research	reasonably consistent results, sufficient sample size, some control, with fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence
	Summative reviews	reasonably thorough and appropriate search; reasonably consistent results with sufficient numbers of well defined studies; evaluation of strengths and limitations of included studies; fairly definitive conclusions.
	Organizational	Well-defined methods; reasonably consistent results with sufficient numbers; use of **reliable and valid** measures; reasonably consistent recommendations
	Expert Opinion	expertise appears to be credible.
C Low quality or major flaws	Research	little evidence with inconsistent results, insufficient sample size, conclusions cannot be drawn
	Summative reviews	undefined, poorly defined, or limited search strategies; insufficient evidence with inconsistent results; conclusions cannot be drawn
	Organizational	Undefined, **or** poorly defined methods; insufficient sample size; inconsistent results; undefined, poorly defined or measures that lack adequate reliability or validity
	Expert Opinion	expertise is not discernable or is dubious.

Newhouse R, Dearholt S, Poe S, Pugh LC, White K. The Johns Hopkins Nursing Evidence-based Practice Rating Scale. 2005. Baltimore, MD, The Johns Hopkins Hospital; Johns Hopkins University School of Nursing.