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# Tulane STAR (Sending Texts, Advancing Results): impact of text messaging on bariatric post-operative protocol compliance

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## Abstract

**Background** Text messaging is frequently employed in the outpatient setting to communicate with or send reminders to patients. However, there is a paucity of literature on the impact of text messaging on inpatient care. In this study, the use of text messaging in hospitalized patients is evaluated by assessing patient compliance to a post-operative bariatric protocol.

**Methods** This was a randomized controlled trial that studied compliance to a post-operative bariatric protocol in patients who underwent bariatric surgery at a tertiary, academic medical center between February and May 2021. Patients were randomized to either the control group, in which they received standard post-operative education alone or the Tulane Sending Texts, Advancing Results (STAR) intervention arm, in which participants received the same post-operative education along with two text message reminders to drink water, use their incentive spirometers, and ambulate (per post-operative instructions) on post-operative day (POD) # 0 and POD # 1. The primary outcome was compliance with the protocol, defined as the number of 1-oz cups of water consumed, incentive spirometry usage, and ambulation frequency and distance. Secondary outcomes include length of stay and complications.

**Results** A total of 35 patients were enrolled in the study (17 control, 18 STAR intervention). There was no significant difference in age, BMI, or type of surgery performed between the two groups. Clear liquid consumption was significantly higher in the STAR intervention group with an average of $27.7 \pm 3.5$ cups as compared to $18.2 \pm 8.9$ in the control group ($p < 0.001$). Similarly, statistically significant increases in incentive spirometry usage ($p < 0.01$) and ambulation distance and frequency ($p < 0.02$) were observed in the STAR intervention group.

**Conclusions** While patients are in the hospital, text messaging can improve compliance to post-operative protocols. Perioperative text messaging can enhance patient education and communication.

**Keywords** Text messaging · Inpatient · Bariatrics · Ambulation · Incentive spirometry

Evidence-based post-operative protocols are associated with improved outcomes for bariatric surgery patients [1]. Studies show that early and frequent post-operative ambulation and early consumption of clear liquids increase the rate of recovery in patients undergoing bariatric surgery [1]. At our tertiary academic center an enhanced recovery after surgery (ERAS)-based protocol, similar to those proven in the literature, has been shown to be effective at helping patients recover quickly in anticipation of discharge home on post-operative day (POD) #1 [2]. The success of the ERAS protocols is based on compliance, and therefore can be challenging to maintain at times as a large portion of the protocol is patient driven and requires their initiation and active participation. Given this observation, we sought to improve compliance and actively engage patients in our ERAS protocol. We developed a strategy to remind and prompt patients, through the use of text messaging, to participate in the voluntary aspects of their post-operative recovery.

Text messaging has been utilized in the outpatient setting, including for outpatient clinic reminders and peri-hospitalization care, and has demonstrated success [3]. While successful in the outpatient setting, there are few studies evaluating the utility of text messaging during inpatient

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hospitalization. Some evidence-based studies identified a role for a communication system via an electronic health record portal that can result in improved patient and family involvement and understanding of a care plan [4, 5]. There is emerging evidence demonstrating a possible role for inpatient text message reminders for protocol implementation although this is limited [6].

In this study, we evaluate the role of text messaging in post-operative bariatric care through the implementation of a reminder platform titled Tulane Sending Texts, Advancing Results (STAR). We hypothesized that text message reminders sent to patients would improve compliance to our protocol, specifically by increasing the amount of clear liquid consumed (measured as 1-oz cups of liquid), improving incentive spirometry usage, and promoting more frequent and longer ambulation.

## Materials and methods

### Study design

Institutional Review Board approval (IRB) approval was obtained prior to beginning study activity. The study was a single center, randomized controlled trial conducted at a tertiary medical center in New Orleans, LA from February to May 2021. Subjects were patients undergoing primary and revisional laparoscopic (including robotic-assisted) bariatric surgery of any type (sleeve gastrectomy, Roux-en-Y gastric bypass, or duodenal switch) by either of two board-certified Minimally Invasive/Bariatric Surgeons. Inclusion criteria included age $\geq 18$ years, English-speaking, ability to ambulate with or without assistance, and possession of a personal cell phone capable of receiving text messages. Exclusion criteria included being visually impaired or blind, the presence of a neuromuscular disease, inability to perform any component of the protocol, incarceration, or having restrictions to ambulation.

Patients were randomized to two groups using a coin flip—the control group and the Tulane STAR group. Heads represented the control group and tails was the intervention (Tulane STAR text messaging) group. The control group received standard education provided by the attending surgeon, resident, nursing, and ancillary staff. The Tulane STAR group (intervention arm) received the same education combined with text message reminders. The primary outcome was the difference in amount of clear liquids consumed, frequency of incentive spirometry usage, and frequency/distance of ambulation compared between the intervention and control groups. The amount of liquid consumed was measured by counting the number of 1-oz cups as a surrogate for the exact volume, with the idea that each of them were filled equally as educated. Secondary outcomes included hospital length of stay and post-operative complications. Complications were defined as the inability to tolerate oral intake, ileus, venous thromboembolism, post-operative infection, emergency department (ED) visit within 30 days of discharge, or readmission within 30 days.

The text messaging reminder platform, Tulane STAR, consisted of two reminders—the first was sent in the evening of post-operative day (POD) #0 and the second in the morning of POD #1. The reminders were sent via Google Voice, a free internet phone, and text message service that transmits from an anonymous number. These text messages contained reminders to drink liquids, use their incentive spirometer, and ambulate in the hallway around the nursing station. Each patient in the intervention group received an identical text message reminder between 5 and 6 PM on POD #0 stating, "Remember to keep drinking water! Aim for 1 oz of water every 15 min or 4 every hour. Make sure to go for a walk in the hallway tonight and use your incentive spirometer 10 times every hour. From your Tulane Bariatric Surgery Quality Improvement Team. Please reply "Stop" if you would like to opt out." The following morning (POD #1), between 6 and 7 AM, patients received another text message stating "Keep it up! Continue to drink water, walk in the hallway, and use your incentive spirometer 10 times every hour. From your Bariatric Surgery Quality Improvement Team. Please reply "Stop" if you would like to opt out." Later that same day on POD #1, typically 12 PM–1 PM, all patients were approached by a member of the research team and asked about the number of 1-oz cups they consumed, number of times per hour they used their incentive spirometer, and number of times and distance ambulated.

### Statistical methods

Patient demographics, number of 1-oz water cups consumed, ambulation frequency, and incentive spirometry use were compared for the STAR group and control group. Two-tailed Chi-square or Fisher's Exact tests were used for categorical data, while Student's $t$ or Mann–Whitney $U$ tests were employed for continuous variables. Statistical analyses were performed using SPSS v27 (IBM; Armonk, NY). The level of significance was set at $p \leq 0.05$.

## Results

### Participant recruitment

From February to May 2021, 46 candidates were evaluated for the study. As seen in Fig. 1, 35 patients met inclusion criteria and were included in the study, 1 was excluded due to difficulty with vision, and 10 preferred to be excluded given inability to ambulate independently without limitations such

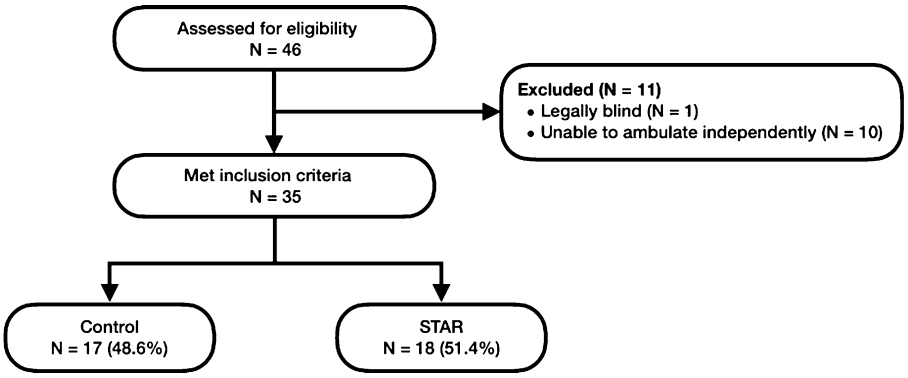


**Fig. 1** Flow diagram of study patient population

**Table 1** Demographic and clinical descriptors for the total study patient population, control group, and STAR group

| | Cohort $n=35$ | Control $n=17$ | STAR $n=18$ | $p$ |
|---|---|---|---|---|
| Age | | | | |
| Mean ± SD | 42.2 ± 9.8 | 42.5 ± 8.3 | 41.9 ± 11.3 | 0.86 |
| Gender, *N* | | | | |
| Male | 1 | 0 | 1 | 0.99 |
| Female | 34 | 17 | 17 | |
| Race, *N* | | | | |
| African American | 21 | 8 | 13 | 0.13 |
| White | 13 | 9 | 4 | |
| Other | 1 | 0 | 1 | |
| BMI | | | | |
| Mean ± SD | 44.4 ± 7.0 | 42.9 ± 5.7 | 45.9 ± 7.9 | 0.21 |
| Surgery | | | | |
| Sleeve | 18 | 10 | 8 | 0.88 |
| Gastric bypass | 15 | 7 | 8 | |
| Duodenal switch | 2 | 1 | 1 | |

*STAR* Sending Texts, Advancing Results, *SD* standard deviation

as joint pain. No medically fit patients declined to participate and all evaluated had access to a cell phone that could receive text messages. Eighteen of the 35 patients included in the study were randomized to the intervention group, while 17 were randomized to the control group.

Baseline demographic characteristics of the patients enrolled in the study can be found in Table 1. Mean age of all participants was 42.2 ± 9.9 with a range from 24 to 62 years old. There was a strong female predominance in this study with 97% of the enrolled patients identifying as female, but there was no statistically significant difference between the groups. The average BMI in the study was 44.4 ± 7.0 with a range from 32.2 to 56.2, with no statistically observed difference between the control and intervention arm. The various types of surgeries can also be observed in Table 1, showing a number of both laparoscopic sleeve gastrectomies (51% of all surgeries performed) and laparoscopic Roux-en-Y gastric bypasses (43% of all surgeries performed). Each intervention arm had a duodenal switch procedure that reflected the remaining 6%. There were no statistically significant differences between these populations. All of these surgeries were performed either robotically-assisted on the da Vinci Xi System or laparoscopically. No patients in either group required conversion to an open procedure.

## Primary outcomes

The primary outcomes included (1) number of clear liquids consumed (measured via 1-oz medicine cups), (2) incentive spirometry usage, and (3) ambulation. The average number of 1-oz medicine cups consumed in this time period described above in the methods was 18.2 ± 8.9 for the control (education only arm) and 27.7 ± 3.5 ($p=0.001$) in the intervention (education and text message reminders) group. With regard to incentive spirometry usage, there was significantly more frequent usage of the incentive spirometer among those in the STAR intervention group (Table 2). Participants in the intervention arm were more likely to use their incentive spirometer > 5 times per hour relative to those receiving education only ($p=0.02$). Likewise, the STAR intervention group showed a significant increase in both distance and frequency of ambulation, as shown in Table 2. Participants in the intervention group were more likely to get out of bed to walk to the bathroom and also to walk in the hallway around the nursing station ($p=0.01$).

## Secondary outcomes

There was no significant difference in the hospital length of stay between the two groups. The control group had statistically greater emergency department visits within 30 days of discharge with four patients in the control group having complications in contrast to zero post-operative complications within the STAR group. Reasons for 30-day emergency department visits included vague abdominal pain (3) and constipation (1).

**Table 2** Clinical outcomes for the study population, control group, and STAR group

| | Cohort $n=35$ | Control $n=17$ | STAR $n=18$ | $p$ |
|---|---|---|---|---|
| # 1 oz cups | | | | |
| Mean ± SD | 23.1 ± 8.2 | 18.2 ± 8.9 | 27.7 ± 3.5 | < 0.001 |
| Ambulation | | | | |
| None | 1 | 1 | 0 | 0.01 |
| In room | 19 | 14 | 5 | |
| Hallway 1× | 13 | 1 | 12 | |
| Hallway > 1× | 2 | 1 | 1 | |
| Incentive spirometer | | | | |
| None | 7 | 7 | 0 | 0.02 |
| 1–5×Total | 17 | 8 | 9 | |
| 6–10×/hr | 10 | 2 | 8 | |
| > 10×/hr | 1 | 0 | 1 | |
| LOS, hours | 22.7 ± 6.0 | 23.9 ± 8.0 | 21.5 ± 2.9 | 0.23 |
| Complications | 5 | 5 | 0 | 0.02 |

*STAR* Sending Texts, Advancing Results, *SD* standard deviation, *LOS* length of stay

## Discussion

Cellular phones that are capable of accepting text messages are universal in today's world and are frequently used for communication in many aspects of our personal and professional lives. Text messaging is gaining momentum as a tool in healthcare and is being used in the outpatient setting to remind patients of appointments, to engage in activities that promote wellness, and to prompt patients to follow discharge instructions. Text messaging patients during inpatient stays is a logical next step in educating patients and encouraging them to participate in their care. There is already evidence that physical activity can be improved through the use of text message reminders sent to patients [7]. In a 2020 systematic review and meta-analysis, Smith et al. report that text message reminders are associated with a statistically significant increase in the number of steps taken per day [7]. This review is critical because physical inactivity is a major risk factor for multiple diseases seen in the bariatric population, including various cardiovascular processes such as hypertension and diabetes mellitus, and has been shown to improve mental health in some populations [8, 9].

Other current uses of text messaging involve increasing awareness around healthy topics and screening for various physical and mental diseases such as HIV and depression to increase early detection and begin intervention sooner [10, 11]. There is also evidence that text message reminders can be used for pre-operative optimization for improved outcomes [12]. A number of programs involved in the post-discharge setting have been developed including postpartum care, post-operative care, and treatment of chronic heart failure and hypertension [13–16]. These programs also support the notion that text messaging with patients can serve to educate, remind about key components of care, and provide positive feedback. Given COVID-19 and the recent pandemic, new efforts must be focused on optimizing and efficiently communicating while patients are in the hospital. While face-to-face communication is ideal, every interaction increases exposure and theoretically, transmission risk of viruses or other infections. Past successes with text messaging as a tool to modify patient behavior, in combination with the challenges posted by COVID-19, caused us to beg the question whether text messaging can be applied to the inpatient setting and improve implementation of post-operative protocols.

In this study, we evaluated the effectiveness of a text message reminder platform on compliance to standard post-operative protocol among bariatric and minimally invasive surgery patients. These text message reminders were effective in encouraging patients to consume a greater amount of clear liquids on POD #0, use their incentive spirometer, and ambulate. We observed a greater consumption of around 9.5 cups between the education and text message and education arms. Likewise, incentive spirometry usage significantly trended towards greater frequency per hour among patients who received text message reminders. Lastly, patients receiving text message reminders were more likely to ambulate more frequently and greater distances.

All but one of the patients in our study population were discharged on POD #1 as per our institution's usual protocol with no significant difference noted in the inpatient length of stay (in hours) between the experimental and control groups. However, visits to the Emergency Department within 30 days of discharge were more likely in the control group than with the STAR cohort. A dedicated study with a larger sample size is required to fully evaluate the impact of text messages on length of stay and complication rate.

This investigation represents one of the few articles in the literature suggesting that text messages can improve compliance with post-operative protocols. As discussed above, perhaps in combination with pre-operative optimization, and post-operative follow-up, text messaging in the hospital can complete the timeline of a patient's care. This could theoretically result in improved outcomes and financial benefits for both the patient and hospital system.

This study has limitations with the first being its sample size. As this study is a pilot to test a hypothesis, it was kept small. Additionally, as patients are frequently discharged on post-operative day #1, the full effects of the text messages on hospital length of stay are limited. We also did not fully study patient-related outcomes in this study, such as satisfaction or pain medication usage to name a few, as

we first hoped to prove text messaging was an effective way to implement a protocol. Patients were understandably not blinded during this study which could have also biased results. This study was also conducted at one hospital system and only offered to patients able to read English text messages which limits its generalizability. However, over fifty percent of our patient population is non-Caucasian. Lastly, the text messaging system we utilized was not automated and required a deliberate effort to send the messages, but this was a purposeful decision. As this was a small study, we did not require the high-volume services that an automated system uses. Furthermore, many of the automated texting programs are fee based and we did not believe a paid service was necessary in a pilot study.

Text messaging in conjunction with education is an effective way to improve compliance to post-operative protocols while patients are inpatient. These data are encouraging and can be used to implement a wide variety of protocols. Further investigation must be done to demonstrate clinically significant details including decreased post-operative complications and the optimum number of text message reminders and the appropriate times.

In conclusion, compliance with post-operative surgical protocols is associated with fewer complications and improved patient outcomes. At our academic, tertiary referral center, reminders sent via text messaging improved compliance to our post-operative bariatric protocol, specifically clear liquid consumption, incentive spirometry usage, and ambulation. Sending text messages to patients while they are inpatient has the potential to improve compliance to other protocols and improve outcomes.

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## Declarations

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