# A feasibility pilot study on the use of text messages to track PTSD symptoms after a traumatic injury

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## Abstract

**Objective**—Monitoring PTSD symptoms after a traumatic injury is beneficial for patients and providers. Text messages can be used to automatically monitor symptoms and impose minimal burden to patients and providers. The present study piloted such a strategy with traumatic injury patients.

**Method**—An automated daily text message was piloted to evaluate PTSD symptoms after discharge from the hospital. 29 patients who experienced a traumatic injury received 15 daily texts and were then followed up at 1-month and 3-months after discharge.

**Results**—82.8% of the sample responded at least once and the average response rate per participant was 63.1%. Response rates were correlated with PTSD symptoms at baseline but not at any other time. Patient satisfaction with this approach was high.

**Conclusion**—Text messages are a viable method to monitor PTSD symptoms after a traumatic injury. Such an approach should be evaluated on a larger scale as part of a more comprehensive early intervention for traumatic stress.

## Keywords

PTSD; traumatic stress; text messages; technology

Approximately 23-31% of adults exposed to a traumatic injury will meet criteria for a psychiatric diagnosis, the most common of which are posttraumatic stress disorder (PTSD)

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and depression [1], [2]. These rates underscore the need for low-cost screening mechanisms that can connect high-risk patients to needed mental health resources. Despite the utility of screening instruments [3], few measures can identify those at greatest risk at the time of the trauma. In the absence of such tools, repeated symptom assessment through telephone follow-up, self-report diaries, and in-person visits are often used to identify those at high risk and facilitate continuity of care [4]–[7]. Repeated assessments, referred to as "watchful waiting", have also been associated with a reduction in psychological distress in the months following a traumatic event [4].

Despite the potential benefits of watchful waiting, it also can impose a significant burden on patients and acute care centers. Patients report that their primary concerns after a traumatic injury are related to their physical health and social functioning as opposed to their mental health [8]. Therefore, patients may have low motivation to complete repeated assessments on mental health shortly after a trauma. Second, patients often are faced with numerous responsibilities in the aftermath of a traumatic injury. Such responsibilities include attending physical rehabilitation, adhering to medication schedules, managing insurance claims, and navigating potential legal matters. Including psychological assessments in this early period may impose additional burden. Third, the stigma associated with mental health conditions is related to reduced use of mental health care [9] and reduced symptom monitoring in those with PTSD [10]. Therefore, those at greatest risk may also be the least likely to engage in repeated assessments.

Acute care centers face barriers in conducting follow-up as well. Comprehensive follow-up assessments require significant resources that may not be available to all trauma centers [11]. For example, a randomized clinical trial used systematic outreach services to screen and treat high-risk patients months after a trauma [12]. Patients were contacted by telephone 3-21 days after discharge and given a standardized telephone assessment. High-risk patients were invited for an in-person clinical assessment for further evaluation and then randomized to a treatment condition. This process involved approximately 7 hours of telephone assessment per patient enrolled in treatment [12]. These estimates corresponded to 2,394 hours of clinical work to provide care to the 342 high-risk patients in the study. In response to this demand, the authors stated that evaluation programs were costly and should be reserved only for exceptionally traumatic events such as natural disasters.

The use of a single assessment telephone assessment to determine risk, a strategy that has been used in other studies [4], [6], may also miss important fluctuations in symptoms [13]. Repeated assessments are preferred, but places increased burden on healthcare providers. A collaborative care treatment that began at a patient's bedside after a traumatic event and continued for a year reported that case managers spent a median of 13.2 hours (IQR = 13.3) per trauma patient [14]. This rate would require approximately 1 full time staff member per 200 admitted patients per year. These data indicated repeated assessments are time intensive and costly.

Healthcare Information Technology solutions have the potential to address many of these issues [15]. These benefits include asynchronous communication, increased privacy, and the potential for automated communication to reduce provider burden [16]. Solutions that

leverage widely available technologies and existing infrastructure, such as text messages, are ideal for conducting repeated assessment after a trauma. Texting allows for brief and asynchronous communication between two individuals via a mobile device. Systems are available to automate the transmission of text messages and record responses to facilitate data collection [17]. Furthermore, text messages are used by 92-97% of adults under age 50 [18], a segment of the population that is at greater risk for PTSD [2], [19]. Thus, a text message assessment strategy could be used to conduct repeated assessments of PTSD symptoms after trauma exposure at minimal burden to patients and providers. However, patient willingness to use such a strategy is unknown.

Consistent with recent recommendations [20], [21], the present study sought to pilot a post-trauma repeated assessment strategy through the use of text messages. The aims of the study were to determine the proportion of trauma patients that would consent to receiving daily text messages assessing mental health, determine response rates to daily text messages among trauma patients, identify predictors of higher rates of responding, assess patient satisfaction, and determine provider burden.

## Methods

### Participants

A total of 31 participants were recruited from a Level 1 Trauma Center. Participants were predominantly male (n = 17; 54.8%), partnered (n = 20, 64.51%), had self-reported race and ethnicity consistent with the surrounding area (White: n = 15, 48.4%; African American: n = 11, 35.5%; Hispanic: n = 2, 6.5%; Pacific-Islander: n = 1, 3.2%; Other: n = 2, 6.5%), and had a mean age of 37.1 years (*SD* = 9.8). Education status varied such that 13 (41.9%) did not complete high school, 4 (12.9%) completed high school, 8 (25.8%) completed some college, and 6 (18.4%) completed college. The majority of participants had private insurance (n = 17, 54.8%), 10 (32.3%) had Medicare or Medicaid, and 4 (12.9%) denied having insurance.

### Measures

**Interviews—**The standardized trauma interview (STI; [22]) is a 41-item interview on relevant aspects of the trauma and related demographic information. The STI was administered in the hospital to determine if the trauma met criterion A for a diagnosis of PTSD. The MINI International Neuropsychiatric Interview for the DSM-IV (MINI; [23]) was administered at the 3-month assessment by a licensed clinical psychologist to determine if patients met DSM-IV criteria for PTSD and, major depressive disorder (MDD).

**Self-report measures—**The posttraumatic symptom scale self-report version (PSS-SR; [24]) is a 17-item self-report measure that corresponds to the DSM-IV criteria for PTSD. Symptoms were rated on a 0-3 scale with total scores ranging from 0-51. Internal consistency ranged from fair to excellent (α = 0.66 to 0.93). The patient health questionnaire 8 (PHQ; [25]) is an 8-item self-report measure that assesses symptoms of depression on a 0-3 point scale with total scores ranging from 0 to 24. The PHQ-8 uses the same items as the PHQ-9, but removes the item assessing suicidality. Internal consistency ranged from fair to

good ($\alpha$ = 0.71 to 0.89). The illness intrusiveness rating scale (IIRS, [26]) is a 13-item self-report measure that assesses the extent an illness interferes with important life activities on a 1-7 point scale with total scores ranging from 13 to 91. The domains were linked specifically to the traumatic event for which the participant presented to the hospital. Internal consistency ranged from good to excellent ($\alpha$ = 0.87 to 0.94). The emotional/information support subscale of the Medical Outcomes-Social Support Scale (MOSSS; [27]) was used due to its association with reductions in PTSD symptoms in prior work [28]. The MOSSS subscale is an 8-item self-report measure assessing perceived caring and empathy from others on a 1-5 point scale with total scores ranging from 8 to 40. Internal consistency ranged from good to excellent ($\alpha$ = 0.88 to 0.97).

**Hospital variables**—Injury severity score (ISS) and length of hospital stay was extracted from medical charts.

**Text messages**—Short Messaging Service (SMS) content (i.e., text messaging content) was developed iteratively with the feedback of 14 experts in the field of traumatic stress, including clinical psychologists, acute care physicians, and nurses. An initial discussion identified five domains for assessment based on the empirical literature: re-experiencing, avoidance, hyperarousal, pain, and social support [29]–[31]. A set of initial items was drafted by the lead author and sent to the panel for review. Feedback was obtained on 5 iterations of the questions before the final item content was selected (Table 1). Items were tailored to fit within a single text message (i.e., were at most 160 characters in length). A 5 item self-report survey also was developed to assess patient satisfaction with the messages. Items assessed satisfaction with regard to frequency of messages (prefer more or less than 1 per day), length of text period (prefer more or less than 15 days), helpfulness of the texts (1: not very helpful – 7: very helpful), and extent to which texts bothered them (1: extremely bothersome – 4: not bothersome).

## Procedure

**Recruitment**—Participants were recruited from the recovery ward of a Level 1 trauma center. A clinical psychologist reviewed the daily census of patients admitted through the trauma service. Patients who presented for an injury that would satisfy criterion A of the DSM-IV PTSD diagnostic criteria (e.g., motor vehicle crash, gunshot wound, stabbing) were approached at bedside. Exclusion criteria included an age older than 55 years, being unable to respond, altered mental status at the time of the initial assessment, lack of a cell phone that could receive text messages, or being in police custody. A total of 87 patients were identified (Figure 1). Few participants declined because of concerns about the use of text messages (n = 2, 2.3%) or were excluded because of a lack of a cell phone (n = 4, 4.6%). Patients were approached within 0.5-9 days ($M$ = 3.41, $SD$ = 2.42) of their traumatic event.

**SMS Communication**—Participants were in the hospital 0-7 days ($M$ = 1.13, $SD$ = 1.24) after enrolling in the study. Research staff entered participants' mobile phone number and date of discharge into the program. Daily texts were sent to participants for 15 days starting the day after discharge. These messages were sent with the assistance of software developed specifically for this project by the Technology Applications Center for Healthy Lifestyles

(TACHL) at the Medical University of South Carolina. The program, Connecting to Help After Trauma (CHAT), was designed to automate the delivery and receipt of text messages to minimize provider burden. The period of 15 days was selected to allow each of the 5 messages to be sent a total of 3 times. A single provider (MP) monitored the transmission and receipt of the texts. Messages were checked daily to ensure that the system was functioning correctly and that none of the messages contained content related to self-harm risk. Participants were not reimbursed for responding to the texts.

Messages were sent according to a planned missingness schedule to maximize data collection and minimize patient burden [32]. Participants received one message per day on a rotating schedule such that day 1 corresponded to message 1, day 2 to message 2, and so forth. Messages were staggered across participants such that participant 1 first received the re-experiencing message, participant 2 first received the avoidance message, and so forth. This approach maximized coverage of the domains such that daily data on each domain was obtained for 1/5 of the total sample.

**Assessments**—Participants completed assessments in the hospital (baseline), at 1 month post discharge (1-month), and 3 months post discharge (3-month). The timing of follow-up was based on the discharge date, rather than the injury date, to ensure that subsequent assessments captured functioning outside of the hospital. A licensed clinical psychologist administered all assessments. The baseline assessment included the STI, PSS, PHQ8, MOSSS, a demographics form, and an introduction to CHAT. The PSS was anchored to their time in the hospital. Participants were contacted by telephone at 1-month and 3-month to complete follow-up assessments via telephone. Assessments involved reading questions and choices to the PSS, PHQ8, MOSSS, and IIR verbatim. Participants who could not be contacted via telephone were sent an e-mail with a request to either contact study staff to complete the measures via telephone or to complete the measures via an online survey. A subset of participants ($n_{1\text{-month}} = 8$, $n_{3\text{-month}} = 1$) completed the measures online. The MINI was administered only over the telephone at the 3-month assessment.

### Analysis

Analyses were descriptive due the preliminary nature of the study. Correlations assessed the association of both response rates, and satisfaction with the texts, with various participant characteristics. In addition, ANOVAs were used to compare average response rates between those with and without PTSD, and degree of symptomatology between those preferring one text message per day versus a text message every other day.

## Results

Two participants were excluded from the sample due to the length of their hospital stay (> 20 days), reducing the analyzed sample to N = 29. Descriptive information is provided in Table 2.

Of the 29 participants who were sent texts, 24 replied at least once for an adherence rate of 82.8% (17.2% noncompliance rate). Four participants who did not respond to any texts reported in follow-up assessments that technological difficulties prevented their response.

These included changing their phone number (n = 2), changing their service plan such that they were unable to receive text messages (n = 1), and denying the receipt of any messages (n =1). Of the 24 participants who replied, the average response rate per person was 63.1% (*SD* = 29.2%; Range = 13%-100%), which corresponded to 9.46 text responses per person. One participant was considered a dropout because they stopped replying to messages after the third day. This person was retained in all subsequent analyses, however. A substantial proportion of the sample (41.7%) responded to over 75% of the messages.

Provider burden during the text message and 1-month follow-up phase was minimal. Records suggest that approximately 2-7 minutes were spent per day monitoring incoming messages. No patients reported information that indicated self-harm or harm to others in the messages. Follow-up assessments conducted via telephone took approximately $M = 27.5$ (SD = 4.5) minutes per participant and an additional 106 minutes (53 calls at approximately 2 minutes) were spent on phone calls that did not result in an assessment (e.g., no answer, respondent answers but is unavailable, respondent reschedules). Taken together, staff time throughout the course of the study was roughly 35 minutes per patient, including daily monitoring of the texts, follow up assessments, and attempted phone calls.

Rates of responding were positively correlated with PTSD symptoms at baseline, $r = 0.67$, $p < 0.01$. However, response rates were not correlated with PTSD symptoms at 1-month or 3-month follow up. Response rates were also not correlated with baseline, 1-month, or 3-month depression symptoms, disability, social support, ISS, and length of stay ($p's = 0.09$ to $0.85$). There was no significant difference in the rate of use between those with PTSD and those without such a diagnosis at 3 months, $F (1, 14) = 1.31$, $p = 0.21$. However, the comparison showed a potentially meaningful difference in that those who met PTSD criteria at the 3-month assessment replied to an average of 10 messages ($M = 65.8%$, SD = 34.0%) whereas those without a diagnosis replied to an average of 7 messages ($M = 48. 3%$, SD = 26.6%).

Satisfaction data were obtained from 18 participants who responded to the texts. Overall, participants responded positively with 61.1% (n = 13) stating the texts were helpful. Four (22.2%) participants did not have an opinion as to their helpfulness and n = 1 (5.6%) did not find them helpful. Only one participant found the texts somewhat bothersome whereas the remaining participants reported the texts did not bother them. The majority of participants felt the 15-day assessment period was sufficient (n = 14, 77.8%), although 3 (16.7%) would have preferred a longer period. Satisfaction with the texts was not correlated with PTSD symptoms, depression symptoms, disability, social support, ISS, or length of stay for any assessment point ($p's = 0.14$ to $0.97$).

The frequency of 1 text per day was preferred (n = 13, 72.2%) whereas a minority of participants indicated they would have preferred a text every other day (n = 5, 27.8%). Participants with a preference for text every other day reported less severe PTSD symptoms at baseline ($F (1, 17) = 11.96$, $p < 0.01$), 1-month ($F (1, 17) = 20.31$, $p < 0.01$), and 3-month ($F (1, 17) = 9.50$, $p < 0.01$), less severe depression symptoms at 1-month ($F (1, 17) = 18.85$, $p < 0.01$) and 3-month ($F (1, 17) = 6.64$, $p = 0.02$), and less disability at 1-month ($F (1, 17)$

= 5.52, *p* = 0.03). There were no differences between these groups on depression symptoms at baseline or 3-month disability (*p* = 0.56-0.78).

Several participants offered qualitative feedback that suggested the texts were a source of support after their discharge. One participant stated, "My family didn't want to talk about it... I felt like I had someone to talk to about the experience with the texts." Another stated that they appreciated that a medical professional was interested in their recovery, "Someone cared, was concerned, and worried about me... You were concerned about my recovery." Taken together, these findings suggest that the texts were well received and offered support to a subset of patients.

Participants also offered qualitative feedback on improvements. One participant requested that "stop rules" should be available to end the receipt of messages if the patient no longer wanted to receive them. Another participant reported that the avoidance messages did not apply to them because their injury limited their mobility. They recommended that messages be tailored to the specific situation of a patient or that query questions be used to determine if a certain domain should be assessed. Three participants requested personalized messages that included their name and the name of the monitoring provider. Finally, three participants requested that personalized feedback be provided after their response was logged. For example, a patient who reported a high pain score would then receive a text with a pain reduction strategy.

## Discussion

The present study was the first to our knowledge to use an automatic text message protocol to communicate with patients after a traumatic injury. The results of this pilot project demonstrated that text messages are an efficient method of implementing a "watchful waiting" program after a traumatic event. The majority of the sample responded to at least one text (82.8%) with technical difficulties reported as the primary reason for non-response. Participants who responded replied to the majority of text messages (63.1%) with a substantial proportion responding to at least 75%. This approach required less provider time than other studies that have used telephone based follow-ups.

There was some evidence that patients with increased distress were more likely to engage in this approach. Patients with increased posttraumatic distress symptoms at baseline were more likely to respond to messages and those who preferred fewer messages had reduced PTSD symptoms at all assessment points. The desire for increased communication after a trauma is consistent with several meta-analyses that suggest social support reduces PTSD symptoms overall [30] and during treatment [28]. Thus, increased responding may identify those who require additional support after a traumatic injury, but further work is needed. Future work should test this hypothesis by including stop rules in the program and determining if early termination is indicative of reduced symptoms. Similarly, the messages assessed only five specific domains related to PTSD. Prior work has indicated there are numerous areas of concern after a traumatic event that may be important to assess [8]. The benefit of adaptive strategies that can tailor message content to the concerns of a specific

patient should be explored. Tailored content may increase message response rates and could translate to increased engagement with subsequent interventions [20].

Responses rates were not correlated with subsequent mental health symptoms, suggesting that the beneficial effect of symptom monitoring may be unrelated to response rates [15]. This is consistent with work on web-based treatments has suggested that symptom severity and outcomes are unrelated to adherence [33]–[35]. Alternatively, the lack of association could be due to the small sample size. These two studies reported that monitoring significantly reduced PTSD symptoms in 11.9% and 12.4% of high-risk samples [4], [36]. Similar work has shown that PTSD symptoms significantly decline after a trauma [37]. Therefore, the sample size of the current study and lack of a control group prevent conclusions about the potential benefit of this text message approach from being drawn.

The present study had several limitations. The study used a convenience sample of hospitalized individuals injured during exposure to a criterion A event. Future work should integrate screening measures for risk that can be administered shortly after the trauma [38]. The results of the present study should be replicated in a high-risk sample with the addition of a control condition. Obtaining a random sample based on trauma registry documentation would enhance the generalizability of the results. Random sampling would permit cohort differences across important demographic factors such as income status to be examined. Lower income groups are at greater risk for post-injury mental health conditions [2] yet are less likely to have access to mobile phones and use text-messages [18]. Further exploration of technology-based methods in lower income samples is critical to fully evaluate their reach. Second, the current proof of concept pilot recruited a small sample. The small sample size and the response rate did not allow for analysis of the daily assessment data. This approach can easily be brought to scale within a hospital system, which would directly address this limitation. Such data can be used to obtain precise measurements of recovery trajectories in the weeks following a hospital discharge, which would directly inform risk prediction models. Third, a clinical psychologist who worked closely with a trauma center conducted assessments and text message monitoring. Additional implementation research is needed to ensure that health technology approaches that add new components, such as mental health follow-up, are well integrated into the scope of practice of dedicated hospital staff to avoid increasing provider burden. Lastly, the present study scaled assessments after the point of discharge rather than the time of the trauma in order to assess functioning outside of the hospital. However, this approach introduced variability in the timing of follow-up assessments, which could have influenced the results.

Overall, the present study demonstrated that text messaging could be used to efficiently communicate with patients after their discharge from a trauma center. Such an approach placed minimal burden on providers and was largely appreciated by patients. This approach has significant potential to inform clinical decisions after a traumatic injury.

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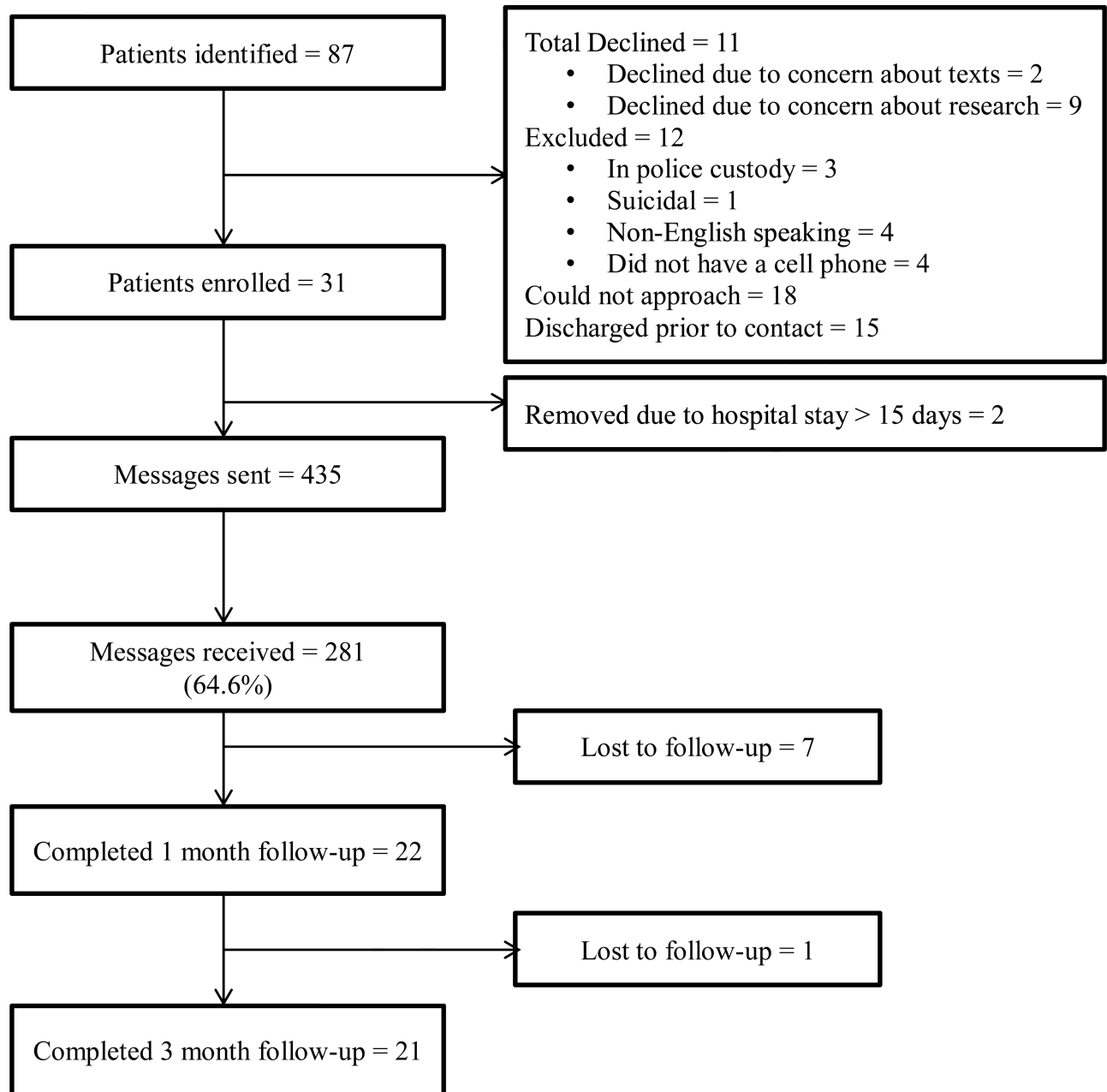
**Figure 1.**
Participant flow through the study.

**Table 1**

Content of text messages to assess symptoms after a traumatic injury.

| Domain | Item |
|---|---|
| Social Support | How supported, close, and/or connected to friends & family have you felt today? (1 = not at all; 7 = completely) |
| Hypervigilance | How much did you feel overly alert, jumpy, and/ or have difficulty concentrating today? (1 = not at all; 7 = all the time) |
| Avoidance | How much have you avoided people, places or activities that may remind you of the trauma today? (1 = not at all; 7 = completely) |
| Re-experiencing | How often did you have negative memories or thoughts about the trauma today? (1 = none at all; 7 = a lot) |
| Pain | How much physical pain were you in today? (1 = none; 10 = a lot) |

**Table 2**

Descriptive statistics for the sample at baseline, 1-month, and 3-months post discharge.

| | Baseline (N=29) | | 1-month post discharge (N=22) | | 3-month post discharge (N=21) | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| PTSD symptoms | 11.56 | 6.35 | 19.73 | 14.31 | 18.14 | 14.88 |
| Depression symptoms | 7.38 | 4.56 | 8.67 | 7.25 | 7.90 | 5.99 |
| Social Support | 34.07 | 6.24 | 32.50 | 9.97 | 32.38 | 11.09 |
| Disability | - | - | 55.29 | 19.67 | 47.94 | 22.99 |
| ISS | 9.68 | 6.15 | - | - | - | - |
| Length of Stay In Days | 7.79 | 8.55 | - | - | - | - |

| | N | % | N | % | N | % |
|---|---|---|---|---|---|---|
| PTSD Diagnosis | | | | | 9 | 31.0 |
| Depression Diagnosis | | | | | 5 | 17.2 |
| Private Insurance | 15 | 51.7 | | | | |
| Medicaid/Medicare | 10 | 34.5 | | | | |
| No Insurance | 4 | 13.8 | | | | |
| Own smartphone | 22 | 75.9 | | | | |
| Prior use of texts | 28 | 96.6 | | | | |

Note: Percentages are out of N = 29. PTSD symptoms were assessed with the Posttrauamtic symptom scale. Depression symptoms were assessed with the patient health questionnaire. Social support was assessed with the medical outcomes social support survey. Disability was assessed with the illness intrusiveness rating scale. ISS = injury severity score. Diagnoses were obtained with the MINI psychiatric interview.