REDACTED Evaluation Post EMA Period - Project SMS

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Sections

NOTE: This is an actual audit done by me on a third-party service used by my research lab. The name of the service has been redacted and replaced with the initials SS for privacy concerns

Outline of Specifications

SS is a platform used by our lab to send SMS messages to participants. A single signal (SMS message) costed the grant $0.10, meaning a purchase of 5000 signals costed $500. We had launched the study during the beginning of August 2020 in which we consistently used SS to send SMS messages to participants. After onboarding, participants would be sent 5 surveys from the following Thursday to Sunday (plus a single survey on Mondays) via SS SMS messages. After 8/16/22, we had begun sending out a Tuesday survey. Participants were sent 3 reminders per survey (according to Paresh this has always been the case), with the exception of the Tuesday surveys, which were just sent two reminders.

Prior to the addition of Tuesday surveys, participants were intended to be sent a total of 21 surveys each week and 168 surveys throughout their total EMA period. This estimates 84 signals spent each week, with a total of 672 signals sent out across the study period per participant. After the Tuesday surveys were sent out, this increased the rates to 22 surveys each week, and 176 surveys throughout the study, estimating to 87 signals sent out each week, and 696 signals throughout the study.

Upon onboarding, further signals were also sent to verify participants' phone numbers and occasionally were used to send pts their baseline survey. Prior to study launch, signals were sent sporadically since March 2020 which we believe was used for testing purposes.

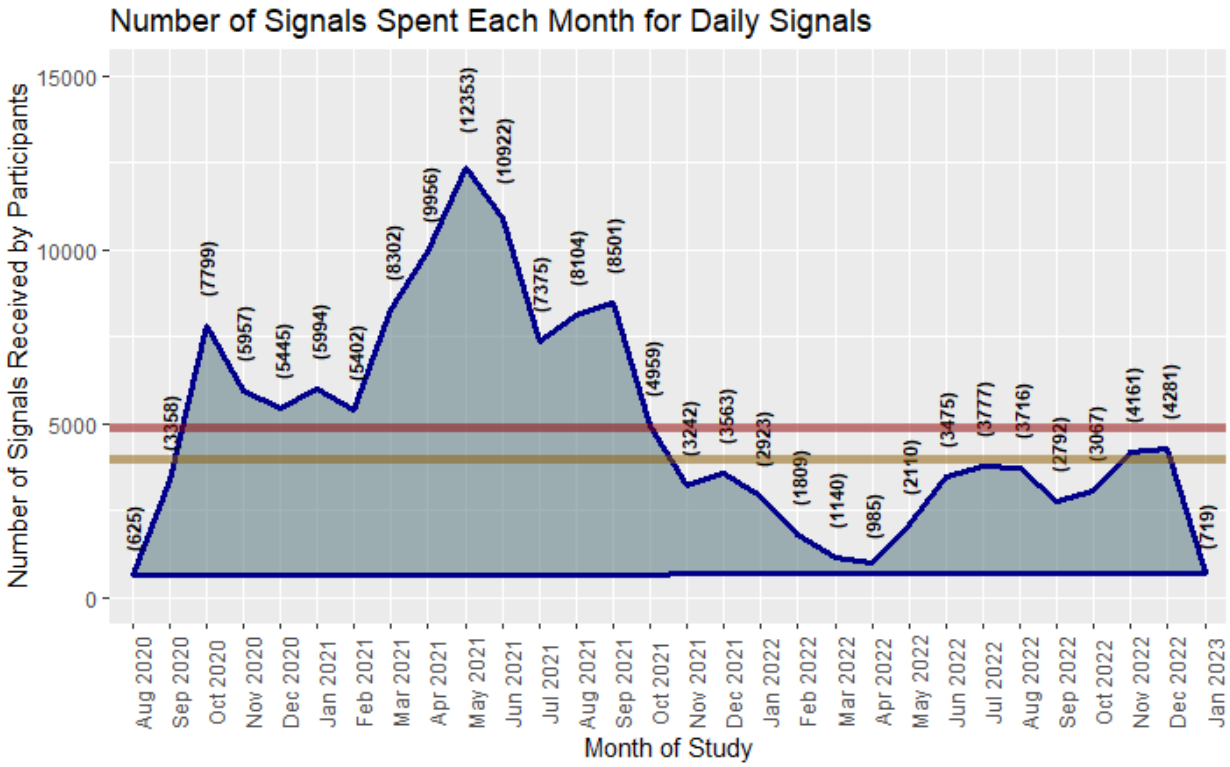
Descriptives of Signals Sent

A total of 151,230 signals were sent across the study period. At the end of Project SMS EMA period, we currently have 5,456 signals remaining. Upon review of an audit of SS receipts, while we have purchased more signals than anticipated, we have received all the signals purchased. Additionally, we were gifted 5,000 and 300 free signals each as an apology for issues with our SS account.

99% of the signals sent were from the daily survey signals and reminder messages. 598 signals were sent to verify registered participants, 210 signals were sent as messages from SS, which we believe is mostly or entirely composed of SMS messages sending out baseline survey links. 1,477 daily signals were sent twice (see section below).

On average, a single participant was sent 9 signals from Thursday to Sunday, with a standard deviation of about 3 signals. Monday and Tuesday surveys were sent about 2 signals with a standard deviation of 1. This indicates that less signals were sent than the study staff would expect. Each participants had average of about 240 signals sent (*sd*: 130) across the EMA period. The majority of participants costed between $11-$37 each to send daily signals.

On average, we had spent an average of 4,900 signals ($490) and a median of 3,969 ($397) monthly throughout the study period. Study recruitment had varied greatly however (for more detail see the recruitment progression reports), leading to a standard deviation of 3,000 signals. Below represents the amount of signals spent each month of the study period. In total, we have roughly spent $14,800 using SS to send SMS messages. The below graph represents the amount of signals used for each month of the onboarding/EMA period. The red line and orange lines represent the mean and median respectively.



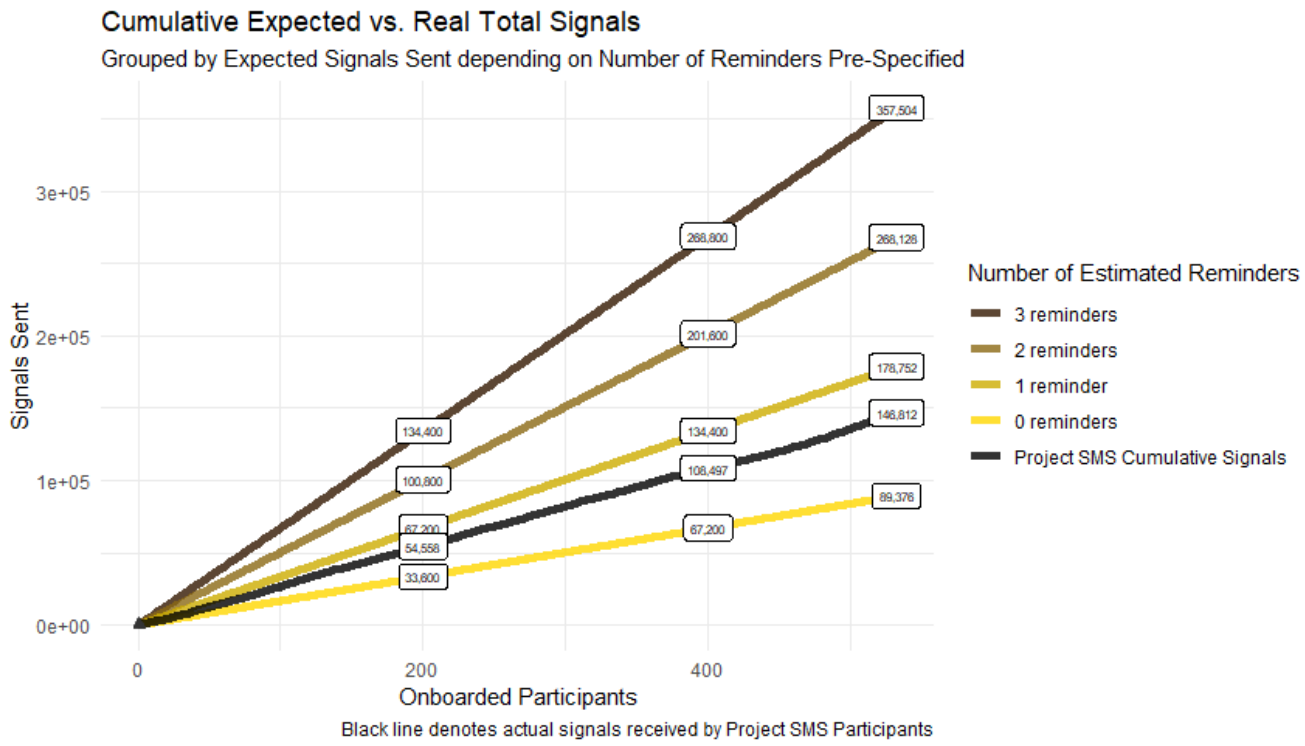
Note: Red line represents average signals spent per month at roughly 4,900 signals, orange line represents median at 3,900

Why are we spending so many signals?

As stated above, the majority of signals sent come from the daily survey signals and their reminders, making up 99% of all the 151,230 signals sent out from our account. We had spent a total of 149,812 signals via the daily surveys, spending about 4,000 to 5,000 signals ($400-$500) each month. The bulk of our signals are expected to come from the survey reminders. According to Paresh, we have always had 3 reminder signals per survey since study launch (one at 20 min, 40 min, and 55min). Comparatively, for our total sample, adding a single extra reminder per each survey can lead to a 1.3-2.0 factor increase in the total amount of signals spent. If all signals including reminders were received, we would have sent a total of 374,528 messages (more than twice the number of signals we actually used). However, as we have had issues with SS consistently not sending out signals, this has led to our final number of signals sent being much lower than expected for having three reminders.

The below table represents the progression of signals we have purchased in the black line, with estimates for how our signal progression should look in our current design but with different numbers of reminders. In total, only 40% of all signals were properly sent. With our data, we have no way of checking how many initial survey texts were not sent. However, occasionally, participants would contact the study staff claiming they were not receiving survey messages, some even saying they missed entire days, and rarely, an entire week.

Note: it may be possible to see how many folks had finished the survey after each reminder, maybe we only need one reminder. We do not have good comparison groups, but we can see if people responded after one reminder but before another.



According to the above graph, if we were to receive all three reminders, we would have reached our current number of signals sent halfway through the full sample. That said, if no reminders were to be sent, our final number of signals would be around 90,000, just 5,000 signals above our original expectation of signals we'd need throughout the study. While participants are sent only 21-22 surveys a week, multiplying this by the number of reminders sent per each survey (*4 for three reminders; 1 survey sms and 3 reminder sms), and then by number of weeks in the study lead to a roughly 670-700 signals for each pt, about $70.

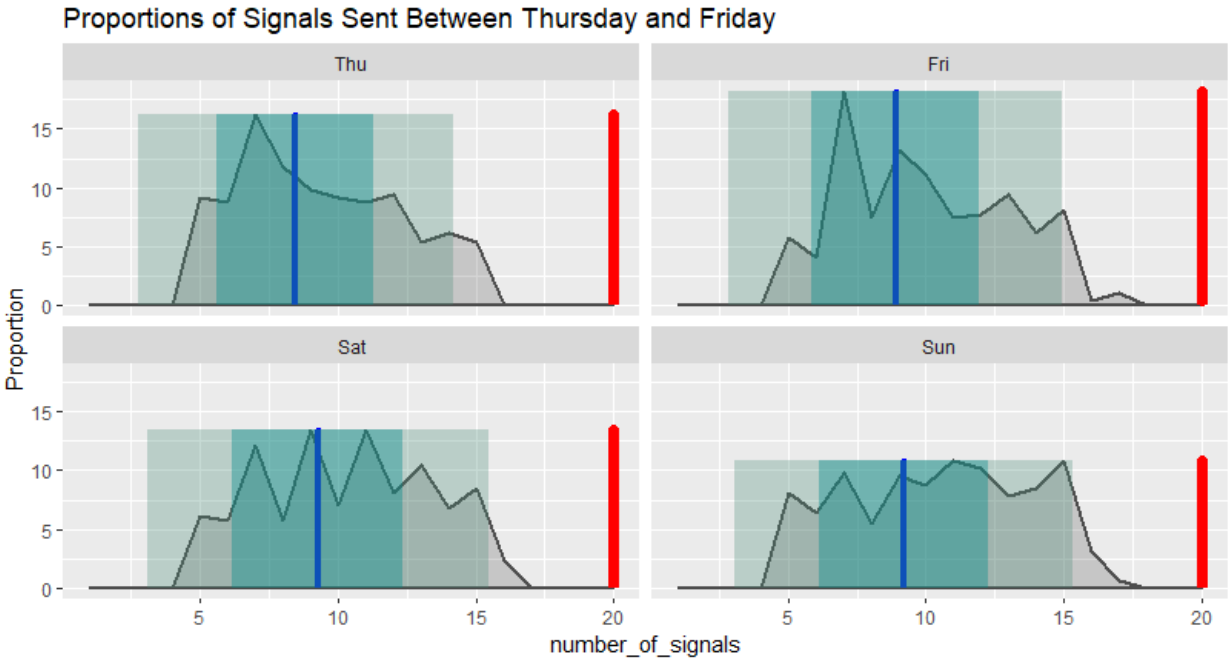
While there are other expenses from SS, the Daily survey reminders make up the bulk of our signals. We may have felt blindsided by the constant need to purchase signals at the time we did because we were likely originally preparing for the number of signals we'd need without reminders. After a certain time, we needed to keep repurchasing signals when the bulk payments we made at the beginning and halfway through the study period began to run out, leading to the bimonthly SS payments during final months of onboarding.

Many expected signals were not sent.

As alluded to already, many participants have contacted study staff about signals not being sent. Paresh had told us that the missing of signals has to do with issues relating to the participant's cell carrier. Several participants who have had issues receiving signals had told us that they have no other issues receiving messages elsewhere, suggesting something is wrong on the side of SS or/with cell carrier issues. Additionally, it occurred once or twice where SS was down and no signals were being sent to participants at all. Finally, occasionally, registered participants would not begin being sent ANY signals, in which case we are recommended to reregister the participant in SS, which has worked to fix the issue most of the time.

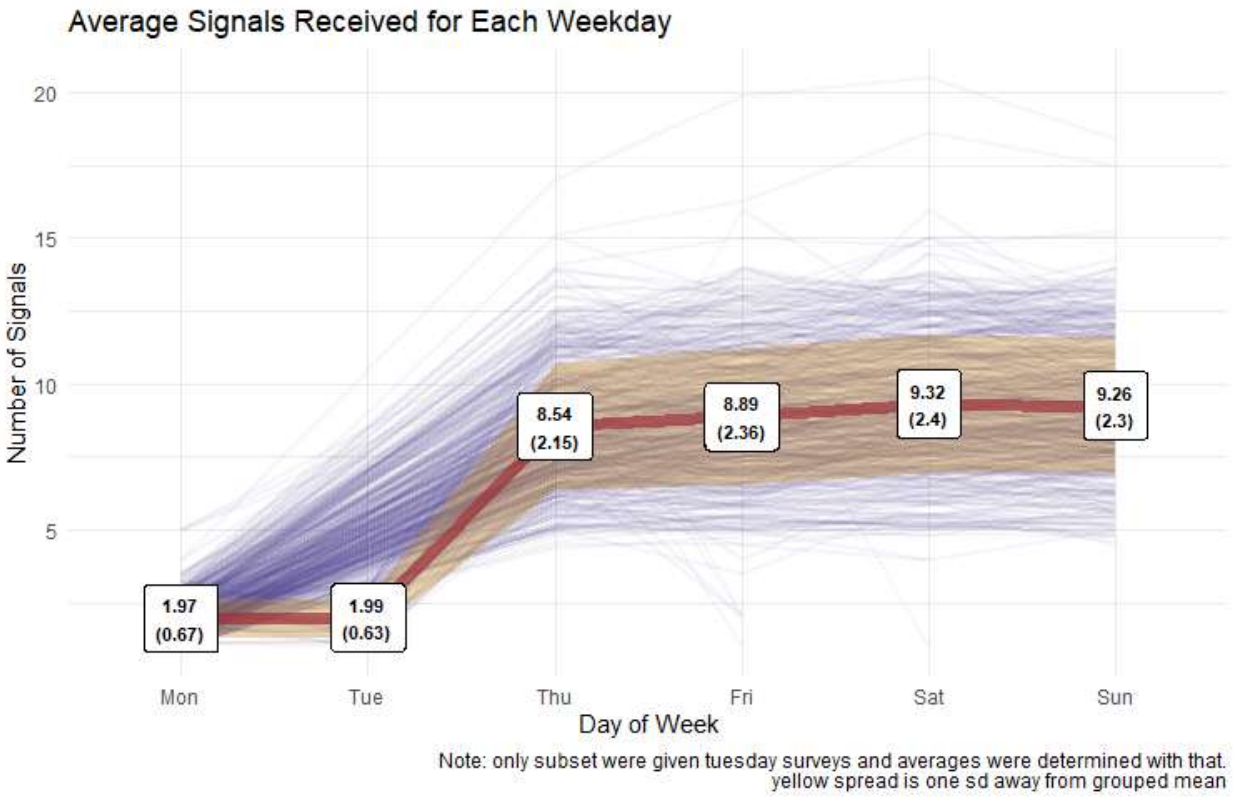
Many reminders were not sent to participants. As mentioned in the previous sections, participants were planned to receive 3 reminders per survey. While we can't tell if a signal sent was a reminder SMS or the survey text, we can estimate a rough average number of reminders participants were sent (i.e. number of total signals received per day/number of expected survey SMS per day). On average, each day, most participants are estimated to have had a single reminder or less per survey. Between Thursday to Tuesday, participants received 1 or less reminders per survey 66%-76% of the days. Additionally, a small proportion of participants had not received any signals on Monday and Tuesday. This was 4% and 1% respectively equating to 156 Monday survey not being sent, and 3 Tuesday surveys not being sent.

Below are two graphs representing the distribution of signals sent to participants. The first graph shows the distribution of proportions for how many signals were sent each weekday. There are colored lines showing the expected signals to be received and the actual mean and spread.



Note: red line denotes expected signals to be sent per PID, blue shade is average +/- 1 sd, lighter shade is average +/- 2 sd.

The second graph represent the actual spread of signals received. Each line is a participant's average signals received for that day, and the label denotes the average and std of the number of signals sent each weekday.



Multiple Signals sent per one SMS

According to our SS account billing table, some participants were sent 2 signals at the same time, in which we would be charged an extra signal. Paresh had told us that this could be because an SMS was over 160 characters, which caused 2 SMS messages to be sent. 96% of our double signals were from daily signals, with only 50 double signals coming from sending the baseline through SS or from participant phone verification. 1,422 of daily signals were sent twice, which come from only 4 PIDs [“100520153706”, “011521150025”, “050421133020”, “063021132119”]. One of these PIDs is Paresh [100520153706], which costed 896 signals ($89.60), and was created in Oct 2020. Interestingly, this means he had used 448 unique signals, but that is a larger total signal amount than 98% our participants. Despite Paresh saying that the double signals are from sending an extra SMS when a text has over 160 characters, these three other PIDs did not have extra-long names, emails, or any information we have on redcap, so it’s hard to say why these PIDs had double signals. If these double signals were a mistake, then we have spent a total of 974 signals ($97.40) extra because of double signals. Including the Paresh PID, this equates to potentially 1870 signals, or $187 spent on unnecessary double signals.

Signals Sent before Launch

Project SMS launched in August 2020, however, in our account we also have signals sent to PIDs from March 2020 to April 2020. These PIDs are not found in redcap and we assume these to be tests from study staff and SS. The signals sent prior to launch are relatively little; only 185 signals from 15 PIDs. March signals were only a small handful (1-10) per PID, with April signals around 20 per PID. Not likely a current concern for study staff.

Takeaways

Throughout the onboarding/EMA period, SS has been our method of sending SMS messages to participants. In some respects, SS has worked fine, which we could see from the fact participants filled out weekly surveys, and the process had become partially automated. With our pre-specified design, a single participant costed the grant between $11-$34 to send signals throughout the study period. This equated to about $3,000-$5,000 spent monthly with a total expense of around $14,800 to onboard roughly 550 PIDs. These estimates would look different for a study using a different number of signals per participant and reminder messages per signal.

SS has also had significant issues that needs to be addressed: 1) The fact that SS has had consistent issues with not sending all SMS messages we had specified originally led to a large loss of possible signals, which we have no way of knowing how many EMA surveys were missed because of this. Only 40% of all signals (which includes reminders) specified in our SS study specifications were sent. 2) We were initially unprepared for the amount of signals we would need for multiple reminder SMS messages, which would have more than doubled our budget if every signal was correctly sent. And 3) We had also experienced issues of 4 PIDs being sent 2 signals for each SMS message. This lead to an extra cost of $97.40-$187 on the grant, which could have been used to onboard between 3-17 extra participants.

While the use of SS has given us participation for our EMAs, further use of SS should consider the likelihood of the incorrect amount of signals being sent, as well as the factor increase for including extra reminder SMS messages per each signal.