

Fostering Engagement of Underserved Communities with Credible Health Information on Social Media

ABSTRACT

The COVID-19 pandemic has necessitated rapid top-down dissemination of reliable and actionable information. This presents unique challenges in engaging hard-to-reach, low-literate communities that live in poverty and lack access to the Internet. Voice-based social media platforms, accessible over simple phones, have shown demonstrable impact in connecting underserved populations with each other and providing them access to instrumental information. We describe the design and deployment of a voice-based social media platform in Pakistan for actively engaging such communities with reliable COVID-related information. We developed three strategies to overcome the hesitation, mistrust, and skepticism depicted by these populations in engaging with COVID content. Users were: (1) encouraged to listen to reliable COVID advisory, (2) incentivized to share reliable content with others, and (3) encourage users to critically think about COVID-related information behaviors. Using a mixed-methods evaluation, we show that users approached with all three strategies had a significantly higher engagement with COVID content compared to others. We conclude by discussing how new designs of social media can enable users to engage with and propagate credible information.

KEYWORDS

COVID-19, health, voice, social networks, Web4Good, ICT4D.

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1 INTRODUCTION

Online health misinformation has caused serious harm to low-income communities in the Global South. Take the case of coronavirus-related misinformation in Pakistan which led people to resist COVID-19 vaccines, physically assault health workers, and follow false health advice that led to hospitalizations and deaths [19]. According to a poll by Ipsos, only 3% of people in Pakistan had no misconceptions about the coronavirus [37]. These risks are particularly high for millions of low-income, low-literate people who are more likely to believe rumors, hearsay, and unverified information [40].

The presence of health misinformation is deeply concerning not only on mainstream social media platforms like Facebook and Twitter, but also on the alternative services that are built for people

who lack the access to smartphones and the Internet. Over the last two decades, *voice-based* social media platforms have been enabling people who are too poor, too remote, or too low-literate to still get the benefits of the Internet [11, 23, 32, 33, 49, 50]. These platforms allow users to call toll-free phone numbers to record voice messages in their local language, and listen and react to messages recorded by others. For example, Mobile Vaani connects over five million people to *infotainment* in the media-dark regions in India [38]. CGNet Swara enables rural populations in India to listen to local news and report grievances [23]. These platforms have shown demonstrable impact in connecting underserved communities with each other and providing them access to instrumental information in diverse domains, including health and civic engagement, among others.

Many scholars have examined the vital role that mainstream social media plays during crises and disasters, for example, by establishing rapid and direct communication from authorities, providing support and information to people in need, and bringing to light the challenges on the ground. However, there is scarcity of research on how voice-based social media platforms are used during public health emergencies by their users who are predominantly low-literate and low-income. Prior work shows that voice-based platforms deployed in such settings face major hurdles in actively engaging the target populations with reliable health information [52]. These platforms have been used mostly for one-way communication between the authorities and the affected communities, to provide them credible information in the form of voice calls delivering audio messages [34, 52]. However, the extent to which users are willing to trust the delivered information, engage with it, and spread it in their own networks remains unknown.

To fill this gap, we designed and deployed a voice-based social media platform to provide reliable health information to underserved communities in Pakistan to prevent them from the risks and harms of misinformation prevalent during the peak of the COVID-19 pandemic. In particular, we examined the strengths and weaknesses of three strategies that we developed to foster engagement with and dissemination of trusted information on the platform: (1) encouraging users to access a curated list of approved health guidelines, (2) providing them incentives to engage with and propagate trusted COVID-19 content, and (3) encouraging them to reflect on their COVID-related information behaviors.

During the six-month long deployment, our platform received half a million calls from 12,000 users, who were predominately low-literate, low-income men spread all across Pakistan, with 96% of them having less than ten years of education and 57% with less than eight years of education. These users recorded over 35,000 audio posts, voted on them 322,000 times, and played them over 2.4 million times. Using a mixed-methods approach spanning quantitative analysis of 459,430 call logs, content analysis of 20,623 audio posts and 82,975 audio comments containing 773 hours of audio data, and qualitative analysis of 1,000 posts and comments, we analyzed how our platform was used by people living in low-resource

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117 communities in Pakistan and the extent to which it succeeded in
118 providing them access to credible health information.

119 Our mixed-methods analysis found that users approached with
120 all three strategies showed higher engagement with COVID-related
121 credible content compared to others. The engagement was not only
122 limited to users listening to trusted messages, but these strategies
123 also prompted users to record their own COVID-related content as
124 well as engage with and share credible content widely with their
125 friends. The users adapted the platform to meet their specific infor-
126 mational, emotional and instrumental needs. Our findings highlight
127 *knowledge engagement* as being more meaningful and relevant for
128 information campaigns compared to *user engagement with the plat-*
129 *form and its features*. We also provide critical insights on how social
130 media platforms (including mainstream social media) can foster
131 user engagement with credible content and outline the inherent
132 challenges in moderating user content to identify misinformation.
133 In doing so, our work makes two important contributions:

- 134 • A six-month deployment of a voice-based social media plat-
135 form in Pakistan, providing insights into how low-literate
136 people engaged with credible health information during the
137 COVID-19 pandemic.
- 138 • Mixed-methods analysis, showing the efficacy of three dis-
139 tinct design strategies to foster user engagement with credi-
140 ble health information.

142 2 RELATED WORK

143 We first describe prior work that highlights the promises and pit-
144 falls of using social media during public health crises along with
145 strategies used by platforms to improve engagement with reliable
146 health content. We then present the novel application of voice-based
147 platforms, accessible over simple phone calls, to spread health in-
148 formation to vulnerable communities in the Global South.

150 2.1 Public Health Crises and Social Media

151 The role of social media before, during, and after crisis situations is
152 well studied in the field of crisis informatics [28]. Initially, social
153 media was seen as a powerful channel for information seeking
154 and sharing at times of crises [7]. Even public health agencies,
155 such as the Centers for Disease Control, recommended using social
156 media to engage the public during emergency situations [35]. Early
157 research in crisis informatics also hailed social media as a means
158 to transmit credible information with crisis responders providing
159 helpful online resources and expert interpretations of the events [6,
160 8, 13, 14]. However, there was a notable shift when scholars found
161 malicious, suspicious, and misleading information spreading on
162 social media. For example, an analysis of tweets during the Zika
163 virus outbreak in 2016 found disconnect between the interests and
164 concerns of the general public and the communication of public
165 health authorities [15] and reported widespread uncertainty and
166 ambiguity [16]. False information resulted in anxiety and panic,
167 further exacerbating the problem [12].

168 A small, but growing body of research has examined the use
169 of mainstream social media platforms during public health crises
170 in developing regions (e.g., dengue outbreak in Bangladesh [41],
171 Ebola outbreak in Nigeria [26]). Scholars have highlighted the high
172 prevalence of misinformation on social media [27] and have noted

175 the complexities of communicating credible information during
176 public health crises, highlighting the social, political and ethical
177 hurdles in doing so [4].

178 With the COVID-19 pandemic, the challenge of accessing cred-
179 ible health information on social media became even more ex-
180 tenuated, with the World Health Organization coining the term
181 *infodemic* – too much information including false or misleading
182 information in digital and physical environments [54]. In response,
183 social media platforms implemented a series of design changes to
184 facilitate the spread of reliable information and curb the spread of
185 misinformation. Facebook created a dedicated space called the Coro-
186 navirus Information Center [21], featuring at the top of the news
187 feed, for people to access up-to-date, reliable information. Similarly,
188 Twitter added a dedicated tab in #Explore called COVID-19 that
189 included curated latest news, such as public service announcements,
190 and tweets from public health experts [18] and also made available
191 a dedicated COVID-19 page at the top of the timeline for users in
192 over 30 countries. Facebook and Twitter also created educational
193 pop-up messages and improved their search algorithms to direct
194 users to credible information from health organizations when they
195 searched for or engaged with COVID information [10, 18].

196 As most of these strategies are nascent, there is no evidence of
197 their effectiveness in spreading reliable health information. Our
198 work fills this urgent gap by deploying a health service on a popular
199 voice-based social media platform in Pakistan, attempting specific
200 strategies to engage users with credible health information, and
201 using mixed-methods to systematically evaluate whether these
202 strategies lead to any change in the spread of and engagement with
203 credible health information by low-literate people.

206 2.2 Social Media for Underserved Communities

207 Mainstream social media platforms exclude billions of people in
208 the Global South who do not have access to the Internet and lack
209 literacy and digital skills. In Pakistan, the region of our research fo-
210 cus, only 17% of the population has access to the Internet [1]. Over
211 the last two decades, several researchers and practitioners have
212 designed *voice-based* social media platforms to connect people who
213 are too poor to afford Internet-enabled devices, too remote to access
214 the Internet, or too low literate to navigate the mostly text-driven
215 Internet. These platforms let users call a toll-free phone number to
216 record voice messages in their local language and listen to and react
217 to messages recorded by others. For example, CGNet Swara [24]
218 enables rural communities in India to report and listen to locally
219 relevant news, grievances and cultural content. The users call a toll-
220 free phone number to listen to and record audio messages in their
221 own languages. Recorded messages are fact-checked, published on
222 a website and the platform, and viewed by activists, bureaucrats,
223 and journalists. Since its inception, CGNet Swara has received over
224 600,000 phone calls, 6,500 reports, and resulted in resolution of over
225 300 grievances. These platforms overcome connectivity barriers by
226 using ordinary phone calls, literacy barriers by using local language
227 speaking and listening skills, and socioeconomic barriers by using
228 toll-free (1-800) lines. Because of their accessible and usable design,
229 these services have demonstrated strong potential to enable infor-
230 mation access and connectivity among underserved communities
231 in diverse Web4Good contexts [11, 17, 23, 25, 29]. In fact, scholars

have termed these voice-based platforms as the "Internet of the Orals" [51].

While several scholars have designed and deployed these platforms to provide health-related information to vulnerable populations in hard-to-reach settings (e.g., maternal care [25, 44], support to people with HIV [22], health information to refugees [47], and training of frontline health workers [53]), there is a scarcity of research that explores the potential of these platforms in providing credible health information to underserved communities during public health crises and disasters. We found only one study that used such platform to spread credible information during a public health crisis. In 2014, Wolfe et al. [52] utilized a peer-to-peer entertainment platform, Polly Sante', to disseminate instrumental information about Ebola in Guinea in eleven local languages. They reported several challenges in meaningfully engage vulnerable groups, including lack of traction of the platform among target users, and low engagement with the delivered information. Our work extends this research by deploying a health service on a popular voice-based social media platform in Pakistan, attempting specific strategies to increase engagement of users with credible health information, and using mixed-methods approach to systematically evaluate the outcomes.

3 SYSTEM DESIGN

We deployed the COVID information hotline over *Baang*, a popular voice-based social media platform in Pakistan [32]. A typical user interaction with *Baang* begins with a missed call. To use the platform, users place a call on the phone number, quickly hangup as soon as it rings, and then expect a callback. The system then calls back and allows the user to record audio posts or listen to posts sorted by recency, popularity, or trending. After listening to each post, users can vote on, comment on, report, and share the post (by entering the recipient's phone number). The system calls up all recipients and delivers the posts after announcing the pre-recorded names of the senders. After playing the shared post, *Baang* lets recipients continue browsing other posts and record their own content. *Baang* was first deployed in Pakistan in 2015 for eight months, during which it virally reached over 10,000 users who placed 269,000 calls and recorded 44,000 audio posts that were played nearly 3 million times. Users also recorded 124,000 audio comments and 343,000 votes on the posts. The majority of users were low-literate, young men from all across Pakistan with a large fraction having no formal education. They included students, teachers, farmers, manual laborers, shopkeepers, and drivers, among others. About 30% of the users were unemployed, more than half had no access to the Internet, and the majority had never used social media.

At the onset of the pandemic in Pakistan, we partnered with *Baang* to: (1) disseminate up-to-date COVID-19 advisory from reliable sources, (2) encourage the users to engage with and propagate reliable COVID content, and (3) curtail the spread of COVID-related misinformation and misconceptions. We developed three strategies to foster users' engagement with and dissemination of trusted information: (1) nudging users to access a curated list of approved health guidelines, (2) providing incentives to propagate trusted COVID content, and (3) compelling them to think critically about the pandemic. We now describe these three strategies in detail.

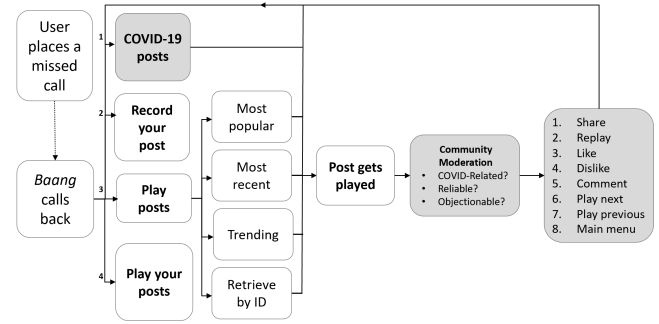


Figure 1: User interface of *Baang* (modifications in gray)

3.1 Nudge Users to Engage with Reliable Posts

To *nudge*¹ users to engage with and propagate reliable COVID advisory, we introduced a new option at the beginning of the main menu of *Baang* (see Figure 1) that allowed users to listen to and share seven short audio messages created based on the guidance from NIH Pakistan [2] and the government of Pakistan [45]. We refer to these messages as the *official COVID posts*. The official COVID posts covered the most essential aspects of the pandemic and its associated risks, the resulting social responsibilities, the channels of disease spread, advisory for healthy and symptomatic individuals, and steps to seeking professional care. Appendix A shows the seven messages that remained live for the entire duration of the deployment, and 16 messages debunking popular myths about the coronavirus. The users were presented these posts in a round robin order (Figure 1). Since this was vetted content, users could not report these posts and their posted comments were not made public to prevent them from becoming a source of misinformation.

3.2 Incentives to Spread Reliable Posts

We made *Baang* toll-free so that people who could not afford airtime could also use it. However, we imposed daily usage quotas to contain the costs. Each user was assigned 30 "Baang-minutes" (BM) on their first call to the platform each day, which allowed them to use the platform for 30 minutes without any restrictions.

We provided several incentives to motivate users to propagate reliable COVID-related information and bring new users to the platform. The incentives took the form of increased usage quotas (described below) that allowed users to spend more time on *Baang* without any costs. A user earned: (1) 5 Baang-Minutes for sharing a post with an existing user, when the recipient answered the delivery call, (2) 10 minutes for bringing a new user to *Baang*, (3) 30 minutes if the new user remained on the delivery call for more than a minute, and (4) 60 minutes when the new user called the platform again.

3.3 Think About Information Behaviors

To encourage users to think deeply about their information behaviors, we created four thought provoking posts that all users were compelled to listen to. These posts encouraged users to adopt good information behaviours, think about the authenticity of sources they rely on to access information, and disseminate reliable COVID

¹A small design change that can markedly affect individual behavior [48]

advisory in their communities. Appendix B shows the content of these posts. These messages were “pinned” to the start of all playlists, one at a time, for 48 hours each. A user was forced to listen to these messages for up to three times after which that particular posts was “unpinned” for that user.

3.4 Ethical Considerations

We took a number of steps to protect the target communities from any unintended harm. To begin with, a team of six paid content moderators listened to all posts and comments within 4 hours of being posted, and removed any content containing misinformation and hate speech. The team also included a public health expert who conducted training sessions and provided detailed content annotation guidelines to the team. Users were also provided with options to report misinformation and inappropriate content. Users found to be repeatedly posting inappropriate content (0.002% of all users) were permanently suspended.

For the official COVID posts, users were informed about the main information source at the start of the interaction. Most of the content was taken verbatim in Urdu from the source websites and was played to the users following the same relative priority as dictated by the sources. Whenever any part of the advisory needed translation, it was reviewed by a bilingual public health expert to ensure the accuracy of translation.

Our study was approved by the Institutional Review Boards of all the involved organizations that had access to personally identifiable user data. Through simply-phrased and elaborate disclaimers, users were informed to engage with the platform voluntarily and refrain from sharing personal information, such as phone numbers and addresses. Users were also informed that their recorded content and activity on the platform would be used for research and to help provide them with better services in the future.

4 METHODS

We used a mixed-methods approach, spanning content analysis, thematic analysis, and usage analysis, to study the engagement of users with trusted COVID-19 content.

Content Analysis. A team of six content moderators performed content annotation of 20,623 audio posts (58% of all posts) and 82,975 audio comments (53% of all comments), spanning 773 hours of audio data which was gathered over the last three months of the deployment. This period was selected for detailed annotation because all of the user engagement interventions were rolled out during these three months. During the detailed annotation period, the moderators listened to each audio message carefully and assigned a hierarchy of tags starting with COVID/Non-COVID, misinformation/reliable, and further tagged the content category. Initially, we assigned 200 audio posts to each coder to fill the rubric and found high inter-rater agreement using Cohen’s Kappa coefficient. We then divided the remaining dataset into multiple non-overlapping partitions and assigned a partition to each coder. The metadata thus generated was central to our analysis to examine the kinds of content generated and propagated on the platform. Table 1 shows the tags which are discussed further in Section 5.2.

Thematic Analysis. We used thematic analysis [9] to examine over 1,000 posts recorded by users, representing nearly seven hours

of audio recordings. We subjected our data to open coding and rigorously categorized our codes to examine the attitudes and perceptions of people around the COVID-19 pandemic, including their responses and sentiments towards COVID-related official and pinned posts. Three authors regularly participated in the coding process and iterated upon the codes until consensus was reached. Over the course of analysis, they discussed coding plan, developed and reviewed codebook, refined codes, and finalized categories and themes. The first-level codes were specific, such as denial of existence of COVID-19, high-cost of COVID testing, and lack of beds. After several rounds of iteration, the codes were condensed into high-level themes, such as misinformation about COVID-19, feedback on government policies, and personal stories.

Usage Analysis. To support our content and thematic analyses, we examined the usage logs from nearly half a millions calls containing detailed user interaction data, such as the time users spent on the platform, interactions with trusted and user-generated content, as well as the number of audio posts and comments they recorded.

User Demographics. We performed a telephonic survey of 300 stratified users of the platform, with 150 randomly sampled participants, and oversampling for (1) 75 users who posted misinformation, and (2) 75 users who were super active users of the platform based on the number of comments they posted. About 93% of the users self-identified themselves as being males. In terms of age, about half of the respondents were between the ages of 30 and 39, nearly 42% were below the age of 29, and the rest were over 40 years old. The users were located all over Pakistan, representing 53 districts. The high majority of the users were low-literate, with 96% who did not go to high school, 57% who did not go to middle school, and about 16% who never finished primary school.

Methodological Limitations. We did not have a pure control group and did not use randomized control trials to establish causal relationships between engagement with the three interventions and engagement with COVID content. This was a conscious ethical decision as we could not justify intentionally depriving any group of users from accessing reliable COVID information at the time of a public health crisis. Instead, our work shows that user engagement with the three interventions (official posts, incentives, pinned posts) is a strong predictor of their eventual engagement with (and spread of) reliable COVID content. Also, future studies are needed to isolate the comparative impact of the three interventions.

5 FINDINGS

We begin by describing the general trends on how users engage with our platform (Section 5.1), before outlining the results of our content and thematic analyses of recorded posts and comments (Section 5.2). In the following three sections, we present the extent to which our three strategies succeeded in fostering engagement with and propagation of trusted content.

5.1 General Usage

We launched COVID information on Baang on Apr 03, 2020 and it remained live until Sept 30, 2020. During these six-months, the platform received very high adoption in Pakistan. Overall, we received nearly half a million calls from over 12,000 users who recorded over 35,000 posts and 156,000 comments, cast 322,000 votes, and listened

Table 1: Frequency of thematic tags for posts and comments (in the decreasing order of the frequency of audio posts)

Topic Tag	Frequency Posts	%	Frequency Comments	%
NotCovid - Religious Poetry Recital	3,903	18.012	961	1.108
NotCovid - Public Game show	2,726	12.580	1102	1.271
NotCovid - Other	2,707	12.493	5031	5.803
NotCovid - Singing/Poetry	2,080	9.599	933	1.076
NotCovid - Personal Comment/Story	1,682	7.762	4166	4.805
NotCovid - Silent	1,598	7.375	3536	4.079
NotCovid - General Comment/Info	1,296	5.981	7333	8.458
NotCovid - Noise	1,181	5.450	2828	3.262
NotCovid - Irrelevant Comment	941	4.343	439	0.506
NotCovid - Profanity/Threats	750	3.461	2109	2.433
NotCovid - Public Moderation	687	3.170	1746	2.014
Unknown Language	482	2.224	925	1.067
NotCovid - Feedback & Invite	293	1.352	53475	61.680
NotCovid - News	279	1.288	118	0.136
NotCovid - Hate Speech	270	1.246	375	0.433
NotCovid - Advertisement	126	0.581	109	0.126
Covid - Comment on Situation	115	0.531	86	0.099
Covid - Other	104	0.480	162	0.187
NotCovid - Sexism & Misogyny	90	0.415	591	0.682
Covid - Prevention & Protection	79	0.365	49	0.057
Covid - Comment on Govt Policies	48	0.222	35	0.040
Covid - Personal Story	43	0.198	48	0.055
Covid - Spread of Virus	37	0.171	9	0.010
Covid - Real/Perceived Impact of COVID	36	0.166	37	0.043
NotCovid - Incitement to Violence	23	0.106	34	0.039
NotCovid - Sexual harassment	23	0.106	215	0.248
Covid - Denial of Existence	21	0.097	37	0.043
NotCovid - Profanity	15	0.069	52	0.060
Covid - Treatment and Cures	12	0.055	2	0.002
Covid - Feedback & Invite	8	0.037	136	0.157
Covid - General Misconceptions	7	0.032	6	0.007
Covid - Creation/Cause Myths	6	0.028	7	0.008
Covid - Social Stigma	1	0.005	5	0.006

to posts over 2.4 millions times. Specific to the official COVID posts, the first seven were played 46,488 times by 4,233 users while the remaining sixteen (myth-busters) were played 8,447 times by 735 users. About half of the users who listened to any user-generated post also listened to at least one official COVID post. These posts were shared 8,629 times by 748 users with 2,951 recipients, liked 2,080 times, and disliked 397 times. Users also posted 1,425 audio comments on these posts. The four pinned posts were played 2,580 times to 1,296 users who shared them 280 times and posted 420 likes, 99 dislikes and 453 audio comments on them.

We found that 178 users recorded 390 posts related to COVID, of which 41 were found to contain misinformation (nearly 10% of all COVID posts and 0.19% of all tagged posts) and were immediately removed from the platform. The remaining 349 COVID posts were played 24,412 times by 1,111 users who shared them 1,499 times, liked them 2,168 times, disliked them 603 times, and posted 1,454 audio comments. There were 536 comments that were about topics related to COVID. The recorded posts spanned 274 hours of audio data, with 5.4 hours of COVID-related content and 21 minutes of content containing misinformation. Similarly, the audio comments spanned 935 hours, with nearly four hours of COVID-related comments, and 30 minutes of comments containing misinformation.

5.2 Qualitative Analysis of Audio Data

Table 1 shows the results based on the thematic tagging of 20,623 posts and 82,975 comments. Of all the posts, nearly 98% pertained

to topics unrelated to COVID including recital of religious poetry (18%), audio game shows – radio game show-themed programs recorded over multiple posts (12.5%), discussions, singing and poetry, news and personal experiences, among others. Among the posts that were deleted from the platform by moderators, 0.1% contained sexual harassment and misogynistic comments, 0.07% were abusive posts, and 4.8% contained hate speech and impolite arguments. Some such comments were also directed towards our team by users whose posts had been removed from the platform due to objectionable contents. In 3.1% of posts, users tried to promote good recording habits via promoting responsible sharing.

Table 1 also shows the 2.4% of posts pertaining to COVID which were further sub-categorized into 13 topics. We then transcribed, qualitatively coded, and thematically organized these posts into the following themes: (1) Comment on government policies, (2) misinformation about COVID, and (3) personal stories, precautionary requests, and other feedback. The first category contains 46 posts that expressed either dismay or appreciation towards government policies to curb the spread of corona virus, the impact of such policies on low-income house holds and daily-wage workers, and advice for peers to strictly follow government guidelines and precautions. The misinformation category contained six posts that were tagged for users spreading myths related to the COVID-19 pandemic and 20 posts that denied the existence of the coronavirus. While there were only a limited number of posts that contained outright misinformation, there were a number of posts that contained valuable health information alongside some factual inaccuracies or traditional healing remedies.

Finally, in the third category of posts people had shared personal stories about their lives during the pandemic, especially in response to pinned posts that encouraged users to engage with COVID content. Some people shared stories about how they or someone in their family got infected, and existing social stigmas around COVID patients. Others asked users for prayers for themselves or their infected family members. There were 67 posts warning others to take adequate precautions and take coronavirus seriously. Most of these posts requested users to wash hands, wear masks, follow social distancing, and wear gloves. A few of the messages gave valuable tips on how to keep your mask clean. A number of the messages were educational and appeared to have been shared by medical professionals or referenced from health agencies.

Having described the general usage trends, we now outline to what extent we succeeded in enabling users to engage with and propagate trusted COVID content.

5.3 Nudges for COVID Content Engagement

We now present the analysis of the behavior of users and their overall engagement with the official COVID posts. To analyze the complete timeline of activities of each user, we only focus on the 6,444 users who started using the platform in the last three months of the deployment, the period for which we have the detailed content analysis of all recorded posts and comments as explained in section 4. During this period, seven admin posts were live and we divide our users initially into two categories: the 1,796 users who listened to at least one official COVID post, and the remaining 4,648 users who never listened to any official COVID post. As described

Table 2: Engagement with COVID content among users who listened (and did not listen) to Official COVID posts

Activity	Among the 1,796 users who listened to at least one official post			Among the 4,648 users who never listened to official posts		
	# Users who did this activity after listening to their first official post	% users	Activity per user	# Users who performed this activity	% users	Activity per user
Recorded COVID posts	40	2.23%	2.55	8	0.17%	1.13
Recorded COVID comments	29	1.61%	2.83	2	0.04%	1.50
Shared COVID post	43	2.39%	1.00	4	0.09%	1.50
Liked COVID post	95	5.29%	3.82	26	0.56%	1.31
Disliked COVID post	28	1.56%	2.29	1	0.02%	1.00
Reported abuse in COVID posts	3	0.17%	1.00	0	0.00%	NA
Reported misinfo in COVID posts	6	0.33%	1.33	0	0.00%	NA
Commented on COVID posts	20	1.11%	1.45	2	0.04%	0.00
Listened to COVID posts	270	15.03%	12.99	112	2.41%	2.08

in Section 3.1, all users were nudged to listen to the official COVID posts and those who listened to these posts, did so willingly.

Table 2 shows the engagement of these two user groups with COVID content. We found that 40 (2.23%) out of the 1,796 users who listened to at least one official COVID post went on to record their own COVID content. On average, they recorded 2.55 COVID posts per user. However, only 8 (0.17%) of the remaining 4,648 users ever recorded any COVID posts. And, even these 8 users, collectively recorded only 9 posts related to COVID (1.19 posts per person). We found these two fractions of users to be significantly different ($\chi^2 = 74.66, p < 0.00001$). We saw a similar trend for other forms of engagement with the COVID content (e.g., voting on user-generated COVID posts, recording COVID comments, sharing user-generated COVID posts, and helping with content moderation) for these two groups, resulting in significant differences (at $p < 0.0001$). These findings suggest that users who listened to the official COVID posts engaged more with COVID content compared to the users who chose to ignore these posts.

Beyond engagement, we also found that the magnitudes of the activities between these two groups (in terms of number of posts, votes, shares per user) were significantly higher in case of users who had engaged with the official posts than those who did not (Mann–Whitney U test, $p < 0.0001$, two-tailed with effect sizes ≥ 0.49). It is also notable that the 40 users who listened to at least one official post went on to record 102 COVID posts and 82 COVID comments after engaging with the official posts, whereas before listening to any official posts they recorded only four COVID posts and one COVID comment even though they were actively posting other kinds of content (31 non-COVID posts and 76 non-COVID comments within the same time frame). To dismiss the possibility that the group of 4,648 users, who did not listen to official posts, might have been passive users who never engaged with any content on the platform, we analyzed their behavior with respect to non-COVID content. We found that these users depict high engagement with the platform in general where they recorded 1,412 posts and 2,929 comments, and shared 3,026 posts. These results show that the engagement of users with official COVID posts is a strong predictor of their future engagement with COVID content.

Next, we analyze the content contributed by the users after listening to the official posts. These users depicted a strong interest in posting COVID-related updates and opinions. Such posts included daily news updates about the lockdown and spread of the coronavirus, and reporting of local events in their villages. They also actively shared and voted on such content, that accounted for 29%

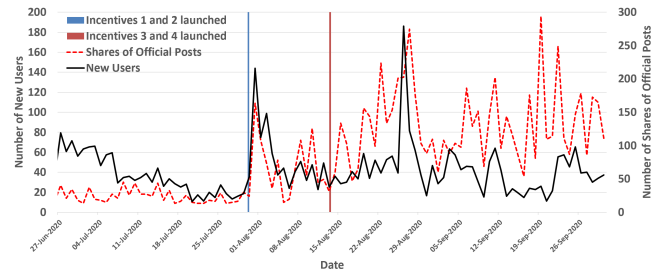


Figure 2: Shares of Official COVID Posts and New Users

of their COVID-related activities on the platform. Further 22% of all engagement was with posts containing general discussions on COVID and included advice about healthy diet to boost immunity, queries about the employment and business situation during the lockdown, complains about the high cost of COVID tests, and comments on the impact of the pandemic. Another 26% of engagement was with posts about prevention and protection from COVID and feedback on the policies of the government. Users showed a keen interest in posts where others shared their personal stories about coping with COVID. Such posts were received warmly with likes and comments containing prayers and well wishes for the patients and for the pandemic to conclude soon. Interestingly, less than 3% of posts contained denial of existence of COVID, conspiracy theories about the origin of COVID, and how the government benefits from the situation in terms of financial gains. These posts met with more dislikes than likes and received very little shares.

Users recorded over 1,000 comments on the official COVID posts. These comments show that the users intently listened to these posts, formulated their own thoughts about the information provided, and while a vast majority of users trusted the information provided, a subset of users disagreed and took the time to share their reasons for disagreement. Largely, this had to do with a clash between the information provided and their personal beliefs and worldviews.

5.4 Incentives for Spreading Reliable Posts

Next, we analyze the outcomes of the elaborate incentives that were offered to users to spread the content posted on the platform to others with a focus on acquiring new users. As the platform was closely moderated, our aim with the incentives was to grow the network of users, and expose a greater number of new users to reliable COVID information. A major impact of the sharing incentives was that the number of shares of official COVID posts tripled from 0.0986 shares per person per day (where 164 users shared these posts with 259 recipients of whom 60 were new to the platform) to 0.307 shares per person per day (where 275 users shared the official posts with 1,819 friends of whom 1,300 were new to the platform). Figure 2 shows the increase in the number of successful shares of official COVID posts after the launch of the forwarding incentives, which resulted in an increase in the number of new users². A comparison of the graph of new users before and after the launch of incentives makes it clear that before the

²Please note that the spike in number of shares around Aug 27 in figure 2 is an artifact of a number of sharing requests not being sent on time and then all being sent at once.

Table 3: Engagement with COVID content among users who listened (and did not listen) to pinned posts

Activity	Among the 582 users who listened to at least one pinned post			Among the 5,862 users who never listened to pinned posts		
	# Users who did this activity after listening to their first pinned post	% users	Activity per user	# Users who performed this activity	% users	Activity per user
Recorded COVID posts	41	7.04%	2.15	13	0.22%	1.77
Recorded COVID comments	21	3.61%	2.33	7	0.12%	1.71
Shared COVID post	88	15.12%	3.61	28	0.48%	1.61
Liked COVID post	25	4.30%	2.32	3	0.05%	1.00
Disliked COVID post	40	6.87%	8.48	7	0.12%	2.71
Reported abuse in COVID posts	3	0.52%	1.00	0	0.00%	NA
Reported misinfo in COVID posts	4	0.69%	0.25	1	0.02%	1.00
Commented on COVID posts	14	2.41%	2.57	6	0.10%	1.17
Listened to COVID posts	265	45.53%	11.86	115	1.96%	4.85

incentives, most of shares of these posts were just among existing platform users.

The 1,300 users brought in through forwarded official posts engaged with Baang via 4,078 phone calls and in turn created 173 posts (12% related to COVID,), 735 comments (3% about COVID) and also engaged with COVID content through votes, shares and listens. Almost all of these users called the platform more than once (that was one of the goals of the incentives), and 596 users (46%) had interactions with the platform that lasted more than a minute. The total time spent by these users on Baang was 9,959 minutes.

5.5 Encouraging Users to Adopt Healthy Information Behaviors

Next, we analyze the association between the engagement of users with the pinned posts and their subsequent engagement with COVID content on the platform. Once again, we restrict the analysis to users who joined in the last three months of the deployment (N=6,444 users). Of these, 582 users listened to at least one pinned post, while the remaining 5,862 did not listen to any pinned post. Table B presents the number and fraction of users from these groups who engaged with the COVID content on the platform, and the scale of those engagements.

Similar to our findings on the official COVID posts, we found that users who were never compelled to listen to the pinned posts, depicted very little interest in recording COVID posts, sharing them, and posting comments and votes on them. In contrast, a significantly higher fraction of users from the group that had been compelled to listen to the pinned posts engaged with COVID content. The fractions of users from both groups were compared pairwise for significance using a Pearson CHI square test, and the results were found to be significant at $p < 0.0001$. The amount of content that these users contributed, shared, and evaluated was also found to be significantly higher than those who were not compelled to listen to the pinned posts ($p < 0.001$, using Mann Whitney U tests, two-sided, with effect sizes ≥ 0.46 except for the number of listens per person, where the effect size is 0.29).

6 DISCUSSION

This work presents the deployment of a health information hotline for low-literate people in partnership with a popular voice-based social media platform in Pakistan. The modalities of voice and simple phones extended the reach of the information campaign to people who are not active users of the Internet due to connectivity,

skill, and affordability barriers. At the same time, we discovered novel challenges and opportunities that were contributed both by the unique modality as well as the target demographics. In this section, we discuss these findings and also map our lessons to mainstream social media platforms.

6.1 Engagement with COVID-19 Content

We found three meaningful ways in which low-literate users of Baang engaged with the COVID content.

Platform adaptation to the information needs of the community. The primary reason for partnering with Baang to launch a COVID information platform was to allow low-literate communities to meaningfully engage with COVID-related content on a platform that they use and is accessible and inclusive to them. Through the qualitative analysis of the content, we find that the platform was successful in achieving this goal. More importantly, we discovered novel and interesting ways in which users utilized the platform features that aligned well with the goals of the campaign. Users rapidly identified the information needs of the community and came up with ways to utilize the platform to respond to these needs. For instance, some users of Baang took it upon themselves to share daily statistics on number of cases and deaths due to COVID-19, akin to popular websites (e.g. the landing page of the New York Times [3]). As a result, this data, while easily available to sighted, literate, affluent citizens of Pakistan, was now available to low-literate people who do not have access to the Internet. We find another instance of such adaption where, just as mainstream social media users attempt to increase trust by embedding actual news footage from credible sources, we observed instances of Baang users recording actual news content from television news shows as their posts. We also found instances of user-generated content that provided updates about official announcements regarding imposition and lifting of lockdowns in their localities, and closure and reopening of schools and businesses. Users also specifically requested others to share information and updates about topics of interest, including lockdown timings, rules, hospital availability, among others.

Platform adaptation to the emotional needs of the community. Social media is not just a source of news and information, but also a platform that is used to aid the processing of and coping with information. The pros and cons of the role of mainstream social media in emotional support and coping have been studied in case of Internet users [39, 42, 43, 46]. However, it is not clear how these findings translate to voice-based social media platforms for underserved populations. The pandemic and its outcomes in the form of lockdown, loss of employment and business, financial and social setbacks has led to a myriad of mental health issues [31]. Even in a patriarchal society, due to the "male ethic of self-reliance" [36], it is often hard for men to vent about their problems and expose their emotional vulnerabilities [5]. However, we find that given the opportunity to do so in an anonymous manner on a voice-based platform, male users opened up, shared their worries and even broke down in their recorded posts, as they discussed personal devastation due to the pandemic. From sorrowful posts about lost income and the subsequent worries, to anxiety about not being able to financially support their families, to fear about expected COVID test results; we found users rapidly adapted the platform

to form community support circles. They reached out to others for prayers and support, and others reciprocated with supportive comments and posts. As such, the platform became a means for people to cope with the vagaries of life in the pandemic. Coping was not just limited to venting. It took the shape of gratitude as well; users returned to thank others who prayed for them when they felt that they most needed it. This depicted instances of a sense of community starting to take shape that was empathetic to each other's needs. Further study needs to investigate the use of voice-based social platforms as safe spaces for emotional support and male bonding. This is critical in societies with limited access to formal and professional mechanisms of support and counseling, and where stresses due to poverty are high.

Platform adaptation to voice grievances. Lastly, we find that users adapted the platform to voice their grievances and requested others (including the administrators of the platform) to convey them to the government. This is very similar to the use case of CGNet Swara [23]. While a number of people supported the government on their actions to curtail the spread of COVID, many expressed their sufferings from the impacts of such measures. From economic costs to mental health costs to educational harms, the platform was used to air such grievances, in the hopes that they make it to higher authorities. This opens up the possibility of the use of voice-based social media platforms by public health authorities in emergencies to discover problems and also to rapidly receive on-ground feedback on their policies and decisions, especially from communities that are inaccessible via Internet-based outreach efforts.

Misinformation and content moderation. The fraction of users that avidly peddled conspiracy theories and blatant falsehoods related to the pandemic was very small. However, we found several posts that presented unique challenges to content moderation. These posts appeared well-intended yet either contained a mixture of reliable information and inaccuracies, or suggested remedies from alternate forms of medicine that could not be verified. Examples of such content were posts where users cautioned others about the hazards of not following government directives of wearing masks and social distancing, but at the same time also recommended over the counter pain medications for people experiencing symptoms, within the same recording. The removal of several such well-meaning posts led to confused and upset users who championed our COVID information campaign and had endorsed the official COVID posts. This presented unique challenges of moderation, but more importantly of educating the users and conveying to them the real reasons why their posts had been removed. Although such cases were rare on Baang, future studies should look into more holistic interventions with increased transparency, where users are clearly informed about the reasons for the removal of their posts and the rationale behind such decisions.

6.2 Implications for Mainstream Social Media

All three interventions described in the paper resulted in higher user engagement with reliable COVID content. As discussed, users who chose to engage with official posts and were compelled to listen to the pinned posts, also depicted greater engagement with COVID content in terms of listening to posts, voting on them with likes and dislikes, posting audio comments on them and sharing

them with others. Further, users who engaged with the pinned posts also recorded more diverse content and responded actively to our appeals of sharing personal stories, news sources, and local updates. User who were provided incentives showed a very high tendency to share reliable posts with others and brought in a large fraction of new users. The senders were required to *endorse* the official messages by sending their recorded names along with the shared posts. Such peer-endorsement has been shown to inculcate higher trust in the recipients compared to expert-endorsed messaging [30]. A fraction of these new users also engaged with COVID content and shared it further, making the reliable posts go *viral*.

Our study was not designed to measure causality. We show that user engagement with the three interventions (official posts, incentives, pinned posts) is a strong predictor of their eventual engagement with (and spread of) reliable COVID content. It is true that users who chose to engage with official posts might have been predisposed towards such content types. However, such strong associations can help with the design of information engagement campaigns in multiple ways. The first application is, of course, to use them to nudge, incentivize, and compel users towards increased engagement with reliable content. A second use case is to use such techniques for screening purposes. With limited resources like airtime and server bandwidth, information campaigns especially at times of emergencies end up imposing usage restrictions on number of users or extent of usage [34, 52]. Predictors of users more likely to engage with reliable messages can help apply such restrictions in a more meaningful and equitable manner and make the information available to the users who are most inclined to benefit from it.

For mainstream social media platforms, the incentives could take the form of soft incentives like medals, tags, verified status, titles, or actual financial incentives like limited-time access to premium services including ad-free usage after a user completes the desired action. Each of our incentives comprised multiple rewards that were built on top of one another. The users continued receiving higher rewards when the recipients of the messages attended the calls, stayed on for more than a minute, and called the platform back later. Therefore, each incentive comprised instant gratification for minimal action and delayed (and higher) rewards for more meaningful outcomes. Similarly, on mainstream social media platforms, the incentives could comprise instant gratification using soft incentives (e.g., badges, titles) and delayed rewards in the form of premium services when the goals of the desired behavior are met.

The compelled exposure to particular messages could be replicated on mainstream social media by anchoring these messages at particular places in the news feed. This could be done with higher levels of persuasion where users are required to watch, read or listen to the entire message before moving on. The nudges could be implemented with messages that pop up at a time when users are expected to be easily persuaded towards the desired behavior, for example, a message "Have you verified the information that you are about to post?" displayed to a user when they are about to share content may nudge them towards posting reliable and trusted information [20]. Users who end up acting upon the nudge could even be relied upon as champions to spread the trusted content to others with their endorsements.

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A OFFICIAL COVID POSTS

Post #	Topic
General Vital Information about COVID-19	
1	What is coronavirus?
2	How does COVID-19 spread?
3	Advice for healthy people
4	Social distancing: Why and how?
5	Who is at a higher risk?
6	What to do if you are experiencing symptoms?
7	When and how to seeking medical care?
Responses to Popular Misconceptions	
8	Only old people are susceptible to COVID-19
9	Once contracted, COVID-19 has 100% fatality rate
10	Shaking hands does not lead to spreading COVID-19
11	Wearing masks in public is an unnecessary precaution
12	Closing down public spaces (e.g. mosques, schools, markets) is unnecessary
13	Eating garlic protects from COVID-19
14	Drinking hot water protects from COVID-19
15	A hot water bath protects from COVID-19
16	Rinsing the nostrils with salty water protects from COVID-19
17	Consuming vinegar, and various steroids and hormones protects from COVID-19
18	Gargling with a solution of bleach and water protects from COVID-19
19	Medicines are available for curing COVID-19
20	Antibiotics can treat COVID-19
21	Only China and US are preparing COVID-19 vaccines
22	COVID-19 only affects people of Chinese and the European origins
23	COVID-19 is man-made and its origin is well-known

B PINNED POSTS

Message content
Please record your COVID-19-related experiences and stories as posts and comments. Share reliable content with friends, especially the ones impacted by the pandemic.
Please record your COVID-19-related news and information sources and also comment on their reliability. Share reliable content with friends, especially the ones who would also like to share their thoughts.
Please record your views and opinions (and those of your friends and relatives) about COVID-19. Share reliable content with friends, especially the ones who would like to share their thoughts about COVID.
Please record your thoughts and opinions about COVID-19. Share reliable content with friends, especially the ones who would like to hear such content.